State of New York

Forest, Fish & Game Commission

Annual Reports
1904-1905-1906

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Forest, Fish and Game Commissioner

of the

State of New York

for

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ALBANY, NEW YORK

1907

Annual Reports

of the

Forest, Fish and Game Commissioner

for 1904-1905-1906

Albany, N. Y., January 2, 1907.

Hon. James W. Wadsworth, Jr.,

Speaker of the Assembly:

Sir:—I have the honor to submit herewith, as required by law, the official reports of this Commission for the years 1904, 1905 and 1906.

Very truly yours,

James S. Whipple,

Commissioner.

148474

State of New York

Forest, Fish and Game Commission

Commissioner	James S. Whipple
Deputy Commissioner	J. D. Lawrence
Secretary	John D. Whish

Superintendent of Forests	William F. Fox
Chief Game Protector	John B. Burnham
Superintendent of Shellfisheries	B. Frank Wood
Fish Culturist	Tarleton H. Bean
General Counsel	John K. Ward

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A REMARKABLE indication of progress in matters conducive to the welfare of the State may be found in the widespread interest in forestry affairs which has recently absorbed the attention of thoughtful people to an unusual extent.

Beginning with the observance of Arbor Day and the minor sentiment engendered by it, public feeling has been aroused until there is now an unmistakable demand from all parts of the State that its Legislature shall make large appropriations for the extension of the public woodlands and for the reforesting of denuded or non-agricultural lands.

Responsive to these expressions of public opinion New York has taken the lead of all other States in formulating a definite policy, and in adopting active measures to ensure the preservation of its forests, the protection of its fish and game, and, by the replanting of waste lands, to make some suitable provision against the timber famine that otherwise must surely come.

An interesting characteristic of this forestry movement in our State is the work recently undertaken in many places by the owners of private woodlands. While advocating earnestly each measure undertaken by the State for the better management of the public forests, at the same time the farmers are taking better care of their own woodlots, the lumbermen are introducing more intelligent methods in the management of their timberlands, and some of the larger lumber and

wood pulp companies have already commenced the work of reforesting the burned or barren areas belonging to them.

A question arises here properly, as to the particular cause or influence which induced this gratifying interest in forestry affairs throughout the State. In reply it may be safely asserted that it is due largely to the propaganda undertaken by this Commission for the purpose of calling attention to the need of a better and fuller understanding of forestry conditions in New York, and arousing public sentiment with a view to the adoption of legislation that would ensure a better management of the remaining forests in our State, both public and private. In conducting this campaign of education it soon became evident that nothing was so conducive to good results as the voluminous, illustrated reports which were issued from time to time by the Department and distributed widely among our people so far as the size of the editions would permit.

These volumes contained not only the annual official reports from the heads of departments, but articles, also, on forestry and allied subjects that were contributed by well-known experts, and which were studied with a deep interest by all who were interested in this important factor in the political economy of our great Commonwealth. As a result the State of New York occupies an advanced position to-day in the progress which it has made in forestry affairs.

These publications have required much care and labor in their preparation, and have been expensive in their production. But, on the other hand, they have been directly instrumental in bringing about good results that far offset their cost. Owing to a pressure of work in our office it became necessary to combine the three last preliminary reports in this one volume in order to bring the publication up to date.

The Commission desires to make suitable acknowledgment here of the valuable articles kindly contributed to this report: that on "Forest Management," by C. A. Schenck, Ph.D., the eminent forester who is at the head of the Forest Academy at Biltmore, N. C., and who has charge also of the Vanderbilt Forest in the same vicinity; the thesis on "Preservation of Timber Used in Engineering Construction," by Harry V. Radford, M.S.; the paper on "Difficulties in Fish Culture,"

by Dr. Tarleton H. Bean, the well-known fish culturist; the article on "The Scarcity of Ruffed Grouse in 1907," by E. S. Woodruff, M.F., a forester and ornithologist; and the interesting monograph on the "Epidemic among Trout at Cold Spring Harbor," by M. C. Marsh, of the United States Bureau of Fisheries. Attention is also called to the report of Dr. Richard M. Pearce, of the Bender Laboratory, on an investigation of the mortality among Adirondack deer, and the review of this report by Dr. Samuel B. Ward.

Favorable mention is also due the artistic colored plates by Denton, Rhead, Thompson-Seton, and Gillette; and the superior gelatines by Watson. Without these illustrations the report would not only have been incomplete, but would have lost much of its educational value.

THE COMMISSIONER.

Report

of the

Forest, Fish and Game Commissioner

for the year 1904

ALBANY, N. Y., *January* 20, 1905.

To the Honorable, the Legislature:

THE Tenth Annual Report of the Forest, Fish and Game Commissioner, which is herewith submitted, follows the lines laid down in the preceding report. As before, the facts presented in connection with each department of the Commission's work are so arranged as to show the taxpayer the actual production for the money expended. It is extremely satisfactory to be able to say again to your honorable body that advances have been made along all the lines of our activity.

The great work of replanting the denuded places in the Forest Preserve has gone on continuously since our last report, and so successful has this work been that it has called forth general approval among experts as well as laymen. Through the efforts of the commissioner an interest has been awakened among some of the largest forest land holders in the State in this very desirable work of tree planting. Railroads, whose business agents have watched with interest the success attending the raising of hardwoods in the Catskill nursery, have sought information on this subject with a view to planting trees on their own lands for the purpose of producing tie timber. The lumber and pulp wood men also have become interested in this project, and it is a matter of satisfaction to be able to state that one of the largest firms doing business in the Adirondack region has advised the commissioner

of its intention to expend at least $10,000 yearly hereafter in replanting its denuded lands. With such forces at work to restore the forests, and with adequate aid given the Commission to carry out its own plans in this connection, the State of New York will as usual take the lead in a great economic project, and each year that passes will see a nearer approach to the restoration of our forests.

General public satisfaction has been expressed with the work of the hatchery system. The value of the inland fisheries of the State and of the salt water fisheries as well has never been properly appreciated, and the statistics presented by the Commission are intended to place these fisheries properly before the public. It is believed that a due appreciation of their value will ultimately result. The timely aid furnished by the legislature last winter enabled the Commission to make much needed repairs to the hatcheries and to inaugurate some extensions made necessary by the increased demands on the part of the people for fish with which to stock the lakes and streams of the State. It is regretted that the aid asked for the department of shellfisheries was not also furnished, as this highly important branch of the Commission's work is growing in value yearly, and the demands upon the Commission in this connection grow also. A patrol boat is much needed for the protection of the oyster beds, and there is great need also for a renewal of the work of lobster culture.

With reference to the game laws it may be said, as they now exist, they are in much better condition than ever before. During the past year there were fewer cases of violations of the law to come up for prosecution than in the previous season, and it is believed that if the laws are retained in their present condition, the record of the coming year will be even better.

In conclusion, the Commission has to say that it sees no reason for recommending any additional legislation. Its best efforts will be directed to the execution of the laws enacted by the legislature, and it is hoped that such legislation will be largely based on the suggestions made by those having charge of the several branches of the Commission's work.

DeWitt C. Middleton,

Commissioner.

Report

of the

Forest, Fish and Game Commissioner

for the year 1905

ALBANY, N. Y., *January* 3, 1906.

To the Honorable, the Legislature:

I TAKE pleasure in submitting the Eleventh Annual Report of the Forest, Fish and Game Commissioner. The work and results of each department of the Commission, herein set forth at length and in detail, furnish accurate information in relation to the money expended and results obtained.

It is very satisfactory to the Commission to be able to say that there has been a marked advance along every line of work with which it is charged by law. Its field of work and usefulness is widespread, bounded only by the limits of the State. It exercises police power, so far as protection to the forests, fish and game of the State is concerned, and it is called upon to discharge a kind of police duty in the enforcement of the Forest, Fish and Game Law within our borders wherever fish swim, birds and game are found, and forests and land owned by the State are situated.

For so wide and extended a territory, with its many daily demands, the police force provided by law is very small. Fifty protectors cannot be expected to discover and apprehend every violator of the law, and it goes without saying that the number should be increased. The records of this Commission show that from the beginning there has been a steady and constant increase in its efficiency and influence for good. The past calendar year is no exception, as amply established by the following facts:

In 1904 there were all kinds of fish hatched, reared and distributed — in round numbers, 111,000,000. In 1905 there have been hatched, reared and distributed from the State hatcheries, 171,000,000 fish of all kinds. A large proportion of this increase over 1904 were game fish, especially trout. The fines and penalties collected in the calendar year of 1904 were $23,636.86. The fines and penalties collected in the calendar year 1905 were $58,548.08, which shows an increase of fines and penalties over 1904 of $34,911.22.

The number of trespasses on State lands reported in 1904 were few; this year, 1905, there have been discovered and reported 85 trespasses previously committed, not including about a half dozen small ones, such as the cutting of firewood. Of these, 23 have been disposed of by compelling the payment of at least three times the value of the timber destroyed. The balance of the 85 are under process of settlement at the same or larger figures, or actions have been commenced and are now pending.

The trespasses committed from May 20, 1905, to December 31, 1905, compare with those previously committed in a like period of time as one to ten.

Without discussing the policy of the Commission in relation to trespassing on State lands prior to my incumbency, suffice it to say that the present policy is to hold all persons strictly accountable under a strict construction of the constitutional provision in relation to the Forest Preserve. That is, that the Constitution means what it says, to wit: "The lands of the State, now owned or hereafter acquired, constituting the Forest Preserve as now fixed by law, shall be forever kept as wild forest lands. They shall not be leased, sold or exchanged, or be taken by any corporation, public or private, nor shall the timber thereon be sold, removed or destroyed." Stating it in another way, the State cannot through this Department, or otherwise, sell or dispose of land or timber of any kind in the forest preserve as now fixed by law. The provisions of the Constitution apply as well to down or burned timber as to green or standing timber. Because of this understanding of the meaning of the Constitution, plainly expressed through the policy of this Department during the year just closed, it can be truthfully said that at this writing there is no trespass being committed in the Forest Preserve, and very little likelihood of any hereafter.

The increase of fines and penalties, the much larger number of fish dis-

tributed, and the decrease in trespasses on State lands, all indicate an increased activity and closer attention to the work of the Departments and the enforcement of the law. This condition and these results are very gratifying to the Commission, and I trust will be equally gratifying to the Honorable the Legislature and the people of the State.

Legal Department

The present method of conducting the legal business of the Commission, in my judgment, is not the best or cheapest that can be devised, and would not be followed or adopted in handling the legal affairs of any private individual or corporation. It is very expensive, dilatory and unsatisfactory. It is hard to manage and control, it costs at least a third more than it should, and is much more expensive than if the Commission had a legal department of its own.

During the last calendar year 796 actions, civil and criminal, have been commenced. There are now 64 cases pending in the hands of the Attorney-General, and 166 in the hands of other attorneys. The Commission has been successful in 536 cases; there were 19 acquittals, juries disagreed in four cases, and four actions were discontinued. Five hundred and sixty-six cases were disposed of, in 186 of which attorneys were engaged. The balance, 380, were disposed of without attorneys by the Commission direct.

The total costs and disbursements for attorneys amount to the sum of $24,677.60. In 1904 it cost for attorneys $22,026.48, or $2,651.12 less than in 1905; yet with that additional expense there has been recovered and turned into the State treasury $34,911.22 more than in 1904. One-half of this amount properly expended, through a well-organized, legal department similar to that which the Excise Commission has, would accomplish fully as much and in a more satisfactory manner. Because of the nature of the legal business and its wide diversity, it will always be necessary, for obvious reasons, to employ local counsel to some extent, although the great bulk of the business could be better handled as above suggested.

Hatcheries

Every effort has been put forth to make the output of the hatcheries now established as large as possible, with the results as shown. Unfortunately the appropriation for the improvement of the several plants was very

small last year. Hence, less work was accomplished in repairing and improving than should have been done. The Saranac Inn hatchery was very much improved; the others, very little.

Substantial repairs and improvements should be made at the Caledonia hatchery. It should be fostered and grown until it is unsurpassed by any in the United States. It has every natural facility,—water, location and surroundings. Because of easy access and its proximity to large centers of population, it is visited by many thousands of people each year. If put in proper condition, it will be an object lesson to all who visit it, creating and stimulating an increased interest in the propagation and protection of fish, and will become very profitable to the people of the State. Liberal appropriations should be made for its improvement, and for acquiring all of Caledonia creek above the hatchery. I sincerely hope that this may be done.

The Commission has made arrangements for, and expects to produce, a largely increased number of fish of all kinds during the year 1906. The facts and figures in detail are fully set forth in the following pages under the "Report on State Hatcheries."

The State has never engaged in the propagation of small mouthed, black bass, although there is a strong sentiment in favor of it. There is no better game or food fish than the black bass. It seems to me very desirable that an appropriation should be made for hatching ponds for this purpose, and that the same be established at an early date.

Shellfish

The report of Mr. B. Frank Wood, Superintendent of Shellfisheries, which is submitted herewith, is very interesting and full of valuable information in relation to that important industry. A very large number of acres of land under water belonging to the State have been leased to oyster planters from time to time under the law providing for such leases, but always at a very low rate per acre as the leasing must be done and is done by advertisement and public sale. The present rate is about twenty-five cents an acre on long term leases. In years gone by the Commission gave perpetual grants at a purely nominal sum.

The property interests of the oyster planters have become very large. The total product in bushels and value is remarkable as compared with

only a short time ago, and in no way does the use of the land pay an adequate or reasonable return to the State. There seems to be no remedy for this situation except by taxation. From necessity a shellfish department is maintained by the State, which has charge and control of the lands, the leasing of the same, and the enforcement of the law on and about the waters of Long Island sound, adjacent bays, and the Hudson river. The cost of maintaining the department is not unreasonable; in fact, it is small. Yet the revenues from the State's property used for this business does not support the department, whereas it should not only pay the cost of its supervision, but should in addition yield to the State a large revenue.

Some idea of the extent, importance and value of the shellfish industry may be obtained by the mere statement of the fact that the total yearly production, based upon such reports as are obtainable, has an indicated value of $10,000,000; and the property of individuals used in the business outside of the land on which oysters are propagated, amounts in round numbers to $1,000,000. The total returns to the State, under the present condition, amount only to the nominal sum of about $2,000. This condition, of course, should be remedied.

State Forests

In the annual report to me of Col. William F. Fox, Superintendent of State Forests, which forms part of this report, will be found a complete, succinct and interesting history of the forest lands owned by the State, their management, origin of title, the acreage, the work of reforesting, and other important facts and figures. While the propagation and protection of fish and game is important and worth much more to the State than it costs, it is of small significance when compared with the value and importance of the State forests. No one doubts the fact that forest timber, shade and fruit trees are absolutely necessary to the proper enjoyment of this life; that our water supply, to a large extent, depends upon the preservation and reproduction of our forests; and that the latter prevent drought as well as excessive floods. The commercial value of our forest lands is enormous; their usefulness as a health resort is indispensable. For these, and many other reasons, the money that is being used for the protection of the forests is well expended, and the work that is being done is not too great.

We have State lands in the Adirondack counties with an area of 1,347,280 acres; within the Catskill counties, about 92,708 acres; a total State ownership of about 1,439,988 acres. During my incumbency in office the Land Purchasing Board has been adding to the park lands in the Adirondacks and Catskills by purchasing at a low price per acre, such lands as it seemed advisable to buy, considering the terms and location, and, also, the comparatively small amount of money set aside for that purpose.

I suggest that a large appropriation for this purpose be made and that land within the parks be purchased as fast as it can be obtained at a fair price. Our State tree nurseries and the reforesting done under the supervision of the State foresters have, and are attracting widespread attention among persons interested in the work throughout the United States. Many visits have been made to this State during the past year to observe the work of the department in its reforesting operations.

Whether wise or unwise, the Constitution prohibits the leasing of cottage sites, or any other land in the forest preserve. In adopting it the people evidently wanted that provision of the Constitution as it is. But, as a practical matter, if this Commission, under proper restrictions and regulations, had the right to lease small cottage sites two important things could be accomplished without any injury to the park lands.

First. A very large revenue could be obtained, somewhere from two to three hundred thousand dollars annually.

Second. Every person building a cottage or a camp, however small, would have a property interest to protect from fire and would become a protector of the forest. Further than that, a public park, now only accessible to comparatively a few people, would become accessible to the masses.

It cannot be said that a business concern as large as the Forest, Fish and Game Commission of the State of New York, and the law which governs it,can be brought up to a state of perfection in a few months, a year, or a much longer time. The work from the first establishment of this Commission, together with the law, has been in a state of evolution until fairly good conditions have now been reached. There are many things, however, yet to be accomplished in both. In my judgment the law should be amended and strengthened in many respects.

The system of licensing fishermen to use nets, which has long prevailed,

proved on examination to be out of date and sadly in need of revision. The reports made by the fishermen themselves and the requirements of other states have been carefully examined and a revision has been made of our fees. We have brought our system up to a business standard in both the lake and river fisheries, and, without entailing any hardship on the fishermen themselves, a considerable increase in the revenues of the Comsion from this source has been made.

The law requiring the Commission to collect a nonresident license fee from all sportsmen entering the State from other states which charge such a fee, has been rescued from its dormant condition and is now being strictly enforced. The outcome has been in the main satisfactory and from this source also, larger returns may be expected in the future.

The moiety system for protectors should be discontinued and their salaries increased, based upon the average of moieties each now receives. The assistant chief protectors should be made first, second, and third assistants with a slight difference in salary in favor of the first assistant.

The law preventing the pollution of streams should be strengthened; also that in relation to prohibiting dogs in the park lands.

Uniform game laws between the States and Canadian provinces for the protection of fish and game should be enacted, and a legal department for this Commission established by law.

The force of protectors should be increased, and the right of the State to close inland waters, not navigable, should be clearly defined.

The suggestion as to shortening the open season for deer by cutting off the last fifteen days is also worthy of serious consideration.

The Legislature in the past has promptly and substantially come to the aid of this department with appropriations of necessary money to carry on the work. It is hoped that this will be continued in the same spirit and with the same liberality as heretofore, and with such necessary increase in the appropriations as the increasing work and growing business of the department demands.

All of which, with the accompanying reports of the various departments of this Commission hereto attached and forming part of this report, is hereby respectfully submitted.

JAMES S. WHIPPLE,
Commissioner.

Report

of the

Forest, Fish and Game Commissioner

for the year 1906

ALBANY, N. Y., *January* 1, 1907.

To the Honorable, the Legislature:

IT is with pleasure I submit the Twelfth Annual Report of the Forest, Fish and Game Commissioner. Herein may be found a report from the head of each department of the Commission which sets forth at length the facts in relation to the work undertaken and accomplished, together with accurate statements of money received, expended and results obtained.

We showed by the last annual report that there had been a marked advance along every line of work with which the Department is charged by law. The percentage of improvement made in 1905, over 1904, has been sustained and the advancement made in all directions indicates as large a percentage of improvement in 1906, over that of 1905, as was shown by the last report over 1904.

The additional protectors provided by the Legislature of 1906 helped us to accomplish that which we have done with greater facility, and the marked improvement in the enforcement of the law is, in quite a large measure, due to the additional help given us.

In 1904 there were distributed from the eight hatcheries about 111,000,000 fish, in 1905 171,000,000, and this year a little more than 230,000,000.

The fines and penalties collected in the calendar year of 1904 are $23,636.66; in 1905, $58,548.08; this year the Department has collected $61,255.63.

The trespasses discovered on State land during the year 1906 were 160 in all; very many of which were small trespasses, and many of them old trespasses. Only 49 new ones have been reported. As compared with former years this is a larger amount discovered and reported, indicating a much greater vigilance on the part of protectors and fire-wardens. There were very few willful trespasses in 1906. Many of the trespasses mentioned are such as were never taken notice of heretofore; such for instance as cutting a tree for fire wood.

During the year 1906, there were of those left over from last year and new ones, 1,211 violations of the law, of all kinds, to handle, of which 293 were placed in the hands of attorneys and disposed of; 596 were handled by this Department direct. Of the 1,211 cases, 889 have been disposed of, leaving 322 in which actions are pending.

The greater number of violations discovered, the increased amount of collections and the greater number of fish produced at the hatcheries, distributed and placed in the waters of the State, indicate a greatly increased activity in the Department, an improved condition in the service over last year, and a determination to apprehend violators and enforce the law.

Legal Department

Since the passage of the act providing for a legal department for the Forest, Fish and Game Commission, all of the cases pending have been transferred to the Forest, Fish and Game Commission by ordersof the court in which the actions were pending, and I am confident good results will come from the change and the work on the whole will cost less money than has heretofore been expended for that purpose. The total costs and disbursements for attorneys for the year 1906 amount to the sum of $15,200, as against $22,026.48 in 1904, and $24,677.60 in 1905. Yet with this smaller amount the Department has handled a much larger number of cases and turned back into the State Treasury a large sum of money.

Hatcheries

Believing that a fish hatchery is like a manufacturing plant in some respects,and should be conducted on as good a business basis as a successful manufacturing plant is,we have put forth extra effort to make the output much larger than it has ever been before, with the result that 60,000,000 more fish were produced this year and distributed than last year, although in 1905 we distributed 60,000,000 more than the year before.

We have constructed at the Constantia hatchery ponds for black bass and will hereafter propagate, and in time distribute from that hatchery small mouth black bass, which has not heretofore been done by this State. An appropriation was made for the purchase of a site and water privileges somewhere near the Hudson River for a shad and bass hatchery. A contract was made with an owner of property about seven miles below Hudson on the Hudson River, but the property, under the contract, has not yet been acquired on account of delay in getting enough more to make it possible to establish the hatchery. The Department has had the necessary grounds surveyed and is proceeding to condemn the same, and as soon as the State is possessed of the title to the necessary land and water privileges, will carry into effect the intention of the Legislature and establish a shad and bass hatchery at that point.

Something more than a year ago, the Saranac Inn hatchery, which is one of the best for rearing speckled trout, was improved and its capacity doubled. The output this year much more than justified the outlay. Some improvments have been made at Caledonia, and more must be made. As stated in my last annual report, the Caledonia hatchery has, by virtue of its location and the water supply, all of the natural advantages which, if properly utilized, would make it the greatest hatchery in the United States. Because of its close proximity to large centers of population, it is visited by thousands of people each year. It should be improved and enlarged; the title to the whole creek and necessary land along the borders of the same should be acquired by the State by purchase or condemnation. An appropriation of money enough to accomplish this would be amply justified by the improvement when made.

More land and water privileges have been acquired at the Bath hatchery and the condition there is much improved.

Artesian wells have been sunk at Coldspring, and a large flow of pure water acquired at little expense for that hatchery.

With a very small increased appropriation the Bemus Point hatchery at Chautauqua Lake could be made to care for and rear a large number of trout of various kinds, in addition to the maskalonge work now carried on at that station. This is very desirable and should be provided for. Reports from all our hatchery foremen are made part of this report and furnish an account of the work at each station.

Shellfish

Mr. B. Frank Wood, the Superintendent of Shellfisheries, has made to this Department a very comprehensive report of his work in that branch of the service during the calendar year of 1906, which is submitted herewith and forms a part of this report.

Because of the small prices received at the advertised sales for land to oyster planters, leasing has been discontinued. The large interests of oyster planters are constantly increasing and the total value of the product has reached about $10,000,000 a year, but in no way does the use of the land pay an adequate or reasonable return to the State. For that reason, in my last report I recommended the passage of a law establishing a system of sanitary inspection of the product and taxation of the property interests grown up under the liberal policy of the State in leasing lands at nominal prices for this purpose. There is no reason why the revenues from the State's property should not at least pay the expenses of the Shellfish Department and also some reasonable amount to the State in the way of an annual revenue. Therefore, I again recommend that a law be enacted to carry out the intentions and purposes expressed in the proposed bill of a year ago along the lines of sanitation and taxation, and that the Shellfish Department be reorganized and made adequate to carry out the provisions and enforce the law when placed upon the statute books.

State Forests

The annual report of Col. William F. Fox, Superintendent of State Forests, which forms part of this report, is, as heretofore, a very comprehensive and interesting history of the forest lands owned by the State, their management, origin of title, the acreage, work of reforesting and other important facts and figures.

The value and importance of the forest land owned by the State cannot well be overestimated. The necessity for the preservation of the forests of the State is great; the necessity for acquiring much more land than that the State now has, is of equal importance; especially is the necessity for both very important in the Forest Preserve territory in the Adirondacks.

We are apt to lose sight of the fact that nearly all of the great rivers of the State have their sources in and flow out of that great upland plateau. One has only to reflect for a moment upon the number and size of these rivers to comprehend the vast importance of the preservation of the forest land in which they rise. Among them are the Hudson, Schroon, Oswegatchie, Raquette, Grass, St. Regis, Saranac, Ausable, Rock, Cedar, Moose, Beaver and Black Rivers, East and West Canada Creeks, each a river of itself, although called a creek, the most important tributaries of the Mohawk.

During the year 1906 there was cut and taken from the woodlands of the Empire State over 1,300,000,000 feet of timber, board measure; a very large proportion of that amount was taken from the Adirondack Mountains. The softwoods are nearly all lumbered off; that is, that part which is fit to cut. The value of all kinds of lumber is daily increasing and soon it will be so great that the lumbering of the hardwood in the Adirondacks will be feasible; the price so much exceeding freight rates and the cost of manufacture that the profits will warrant the lumbering of the hardwood. If the people of the State allow that to occur, and the hardwoods are taken off, the protection of the sources of the rivers which rise in that section of the State will be destroyed and it will be too late to repair the injury.

It is the judgment of the Forest, Fish and Game Commission, as well as of many people well informed upon this subject, that some provision should be immediately made for the purchase of at least a million acres more of land in that region, and thereby preserve forever the forest lands

FOREST SURVEYING.—RE-ESTABLISHING AN OLD LOT LINE IN THE ADIRONDACKS

that are so essential to the welfare, health and prosperity of the people of the Empire State.

The Land Purchasing Board has materially added to the holdings of the State, during the year of 1906 having purchased all told about 80,311 acres, making the total amount of land held at this time by the State 1,520,299 acres. Of that there are in the Adirondacks 1,415,775 acres, the balance, 104,524 acres, being in the Catskills.

The prices paid for land so purchased have been in all cases very reasonable, and the purchases have generally been made where the land joined or was in close proximity to other lands held by the State, with the idea of closing up the State holdings so far as possible. Each purchase has been made after very careful inspection of the land, the timber growth thereon, its location, and its general nature and value. The Land Purchasing Board has bought all land that has been offered at a reasonable price and to which good titles could be shown.

Our State tree nurseries and reforested lands, under the supervision and management of the Superintendent of Forests, continue to attract widespread attention among persons interested in the work throughout the United States. Many have visited both the nurseries and the plantations during the year just passed. It appears to the Commission that much more money could be expended economically and to great advantage in this branch of the work. The State could well afford to reforest two or more thousand acres of land every year, increasing the amount from year to year until the business of reforesting comprehends planting all denuded lands owned by the State.

Fire Wardens

The fire-warden service has been better than any year heretofore, as may be seen by an examination of the report of the Superintendent of Forests herein contained. There were nearly a hundred fires started, all of which were almost immediately extinguished. The fact that there was little or no destruction of timber is not due to unusually favorable weather conditions. In fact, in May the conditions were very bad. The fire-wardens have also been of great service in preventing trespassing on State land, as they now have power in such cases.

Moose and Beaver

The beaver which have been placed in the Adirondack Park are doing well, several colonies of which have been seen during the summer and fall by various people. There seem to be a few moose left of those put in. Protector Ned Ball at this writing reports having seen three during the present month, which indicates that they have not worked north across the St. Lawrence River, as some old hunters feared they would. Of the few heretofore turned out in the Park several were killed by engines on the railroad and by being shot by careless or vicious persons. There are quite a number of elk in the Preserve, all doing well, which will soon be a very attractive feature. I have arranged with the Interior Department at Washington to get 25 beaver from Yellowstone Park, which will be kept at Old Forge during the winter and liberated in the spring. I have also taken up the question with His Honor the Governor, and through him with President Roosevelt, of getting 10 moose from Canada.

It seems very important that we keep species of all the non-destructive natural animals in our park lands in the Adirondacks, and that all the lakes and streams are well supplied with game fish, both of which are a great attraction to nearly all persons who go there for rest and recreation, and furnish in themselves a strong inducement to our people to spend their vacations in the woods. One has only to observe how many people are attracted to the Canadian forests by the fishing and hunting to understand how important it is to this State that the moose, elk, deer, bear and beaver be protected from extermination and kept in the Adirondacks. The great feature of railroad advertising in Canada and many of our States is the fishing and game. Let us not be laggards in this respect.

Changes Suggested in the Fish and Game Law

The last Legislature changed the open season for hunting deer, cutting off the month of September and making it consist of October and fifteen days in November. Such a law enforced will naturally lessen the number of deer killed each year, but not enough. The amended law is open to two objections: First, it makes a space of thirty days between the fishing and

hunting season. Trout fishing closes August 21st, and deer hunting commences October 1st. This is objectionable from the standpoint of the hotelkeeper, summer visitor and guide in the Adirondacks. While it is true that a law to protect game and fish cannot be built on the line of furnishing work to any one, yet if the same object can be obtained by not interfering with the pleasure or business interest of any of our people, this should be done.

Experience has proved beyond question that a great portion of the deer are killed and taken in the fifteen days in November when usually there is snow on the ground. To accommodate all persons and protect the deer, the open season should be from September 16th to October 31st inclusive, and the trout fishing in the Adirondack region should be from May 1st to September 15th inclusive. That would bring the fishing and hunting together, and accommodate everyone and save the slaughter of a great many deer in the Adirondack region.

It is very desirable that a law be enacted providing for a license to be paid by every person using or carrying a gun in the State of New York, the fee to be not less than One Dollar, licenses to be prepared by the Forest, Fish and Game Department, transmitted to county clerks, by them to town clerks, and the license itself issued by town clerks, county clerks and this Commission. A similar law is in force in many states, from which is derived a very large revenue. At the same time the law should make provision for a flat non-residence license of not less than Fifteen Dollars, nor more than Twenty-Five. The present retaliatory non-residence license is of little consequence. The prohibition relating to aliens should be continued as now provided by law.

It was suggested in our report of 1905 that the law preventing the pollution of streams be amended, absolutely prohibiting refuse of all kinds being put into the waters of this State other than tide waters. This subject has been too long neglected. It is of the greatest importance, both on account of the protection of fish life and the general health of the people of the State. Refuse of all kinds should be cared for in a more intelligent and sanitary way.

The law in relation to dogs in the Forest Preserve should be amended so as to prohibit them being taken into the woods at all.

The force of protectors should be further increased by at least ten. There are several counties that have no protectors, and several others where more are needed.

The law in relation to grouse and woodcock should be amended to provide that not more than six birds of either kind can be killed in any one day, and not more than six of either kind transported at one time. The law as it stands is practically a farce, and does not protect to any great extent. So far as possible the State should be divided into sections or groups of counties, and a general law enacted for the open and close season for fish, game, fowl and birds, affecting alike as many counties as possible in a group. As the law stands now it is full of exceptions, and counties with the same condition have different open seasons, which is annoying and useless. By grouping the counties a great many exceptions could be stricken from the law, and it would be understood and more easily enforced.

That part of the Fish and Game Law relating to pike should be amended to include all kinds of pike by whatever name they are known.

The Legislature of 1906 came promptly to the aid of this Department with appropriations necessary to carry on the work. I sincerely hope that the present Legislature will in the same spirit, and with the same liberality as heretofore, aid this Department in caring for the State's property and interest in the forest, fish and game, all of which are totally unlike the many other interests of the State, in that they are perishable and easily destroyed if not promptly and properly guarded and protected. The business of the Department is rapidly and constantly growing, and the work necessarily increasing day by day. The greater activity in the Department has naturally met with a corresponding increased interest among the people which has added very largely to the office work and to the work of the Legal Department. I trust that the improved conditions, as indicated by this report, will be as pleasing to the Legislature as they are satisfactory to the Department.

All of which, with the reports of the various heads of Departments hereto attached, is herewith respectfully submitted.

JAMES S. WHIPPLE,

Commissioner.

A TYPICAL "SUGAR BUSH"

Report of Superintendent of Forests for the year 1904

Hon. DeWitt C. Middleton, *Forest, Fish and Game Commissioner:*

SIR.—In accordance with the requirements of the State Forestry Law I respectfully submit my annual report on the work of the Forestry Department and matters pertaining thereto for the year 1904.

Forest Fires

It is a matter of congratulation that during the past season there has been throughout the forests of the Adirondack and Catskill regions an exemption from fire as remarkable as the great destruction which made the year 1903 a memorable one in the records of this Department. This result was due largely to the favorable weather which characterized the season of 1904, the frequent rains, and the absence of any prolonged period of drought. Furthermore, the thorough organization of the fire-wardens and their deputies in each town, together with the vigilance and activity displayed by these officials, contributed materially to the almost complete immunity from loss in standing timber. Profiting by the unfortunate experience of the previous year, a calamity due, however, to causes beyond their control, the fire-wardens were stimulated to an increased degree of watchfulness and efficiency.

Although the damage to the forest this year was merely nominal, still there were a large number of incipient fires; but these were promptly attended to at the first sign of danger and were extinguished before any loss occurred. Some of these started last spring at times when, by reason of a few days of warm sun and wind, the dry leaves on the forest floor were in a dangerous condition; and had there been no organized force at hand they would, as in previous years, have resulted in fierce flames that swept rapidly through the woods until rain came.

From the consolidated reports of the town fire-wardens in the Adirondack counties it appears that the total area of woodland burned over in 1904 aggregated 1,635 acres, not including meadow or waste land; and that the total damages to standing timber, as estimated by them, amounted to $930. That the loss is disproportionately small is due to the fact that most of the reports were for surface fires that merely burned the dead leaves on the ground without charring the bark on the trees or killing the timber. As one fire-warden described it in his report, "The fire just skimmed over the leaves and did not do any damage to standing timber, as the ground was so damp."

In the Catskill counties, as shown by the tabulated reports of the fire-wardens for 1904, there were 992 acres of woodlands that were run over by fire. On this area the standing timber was injured to an extent estimated at $570.

The loss of timber on the Forest Preserve was very slight. Of the 1,635 acres of woodland that were scorched or burned over in the Adirondacks, only 51 acres belonged to the State; and of the 992 acres thus injured in the Catskills, only 45 acres were State lands. The total damage to State timber in both sections, as estimated on the various burned areas, amounted in all to $81.

There were only two fires of any note in the Adirondacks. One occurred June 20th, on the lands of the Rich Lumber Company, near Wanakena, Township 15, St. Lawrence county. About 100 acres were burned over along the line of a railroad, owned and operated by this company, which runs from Benson Mines to Wanakena, where their mills are located. The tract had been closely lumbered for both the softwoods and hardwoods, and hence the damage to standing timber was comparatively slight. But the fire—which was started by sparks from one of their locomotives—spread to their skidways and consumed entirely the large piles of logs which were awaiting shipment to the mills. The value of the logs thus destroyed was estimated at $5,000 by the company.

The other fire referred to occurred May 6, on the Cornell University tract, and ran over about 200 acres. The greater part of this area had been cut over under the contract with the Brooklyn Cooperage Company to supply its stave and heading mills and wood acid factory at Tupper Lake. As the

Photo. C. A. Warren.

A GROUND FIRE IN THE CATSKILLS.

ground was thickly and deeply strewn with dead tops, limbs, and brush, it made a hot fire, which killed some standing timber on adjoining property. This fire was started by the manager to clear off the brush and debris so that the ground could be replanted with seedling trees, an appropriation of $5,000 having been granted the University by the Legislature for this purpose. The fire once started was soon beyond control, and the fire-warden of an adjoining town had to order in a large force of men to fight it. As the manager kindled this blaze during the close season, in which the State law forbids the starting of brush or fallow fires, he was arrested by Mr. Emmons, the Chief Fire-warden, and fined $200.

Altogether, in the Adirondacks and Catskills, there were 101 alarms, including brush fires on waste lands and the numerous small ones that were extinguished on the spot where they originated. The causes, known, supposed, and unknown, were:

R. R. locomotives	21
Clearing land	20
Smokers	14
Hunters	9
Fishermen	8
Incendiary	4
Campers	2
Tramps	2
Children	2
Firecrackers	1
Burning garbage	1
Burning leaves	1
Lightning	1
Blasting rocks	1
Unknown	14
	101

In nearly all of the above instances the fire-wardens reported the cause as to the best of their knowledge and belief. Although they had good reasons for attributing the fire to the source specified in the report, they lacked the complete evidence on which to convict the suspected

party. For this reason the foregoing statement of causes may not be as accurate as could be desired.

From the details included in the report of each fire it appears that three-fourths of the fires occurred in the spring. The number of fires in each month, incipient merely or otherwise, were:

April	10
May	66
June	6
July	2
August	4
September	1
October	7
November	5

This corresponds closely to the tabulation of dates made in former years, and explains clearly why the Forestry Law forbids the burning of fallows in certain forest towns between April 1st and June 1st, and from September 15th to November 10th.

There were 29 violations of the law prohibiting the burning of brush, logs, or stumps during the close season. Each case was prosecuted successfully by the Chief Fire-warden, and the offenders paid fines varying from $25 to $200 as imposed by the different justices of the peace before whom the delinquents were brought. The total amount of fines thus collected amounted to $1,022.25, not including costs, which were paid by the defendants.

Patrols were ordered out and placed on duty at two different times, authority for their employment having been granted in an amendment to the Forest Law at the last session of the Legislature. Although the rainfall was ample during most of the season, there were times last spring when the conditions became dangerous. After a few days of dry weather the dead leaves on the ground became quite crisp, and surface fires started up along the railroads with alarming frequency, although they were extinguished quickly in each case by the section men or fire-wardens. As a timely precaution patrols were employed at various places in the Adirondacks; and on some railroads, at exposed points, the men were distributed one man to

a mile. But on each of the two occasions mentioned, rain came the day after the establishment of the patrol, and the men were called off.

The railroad superintendents evinced an earnest desire to co-operate with the Commission in its efforts to protect the forests along their respective lines, and one of them sent out a circular which was placed in the hands of each engineer and fireman, notifying these employees that they would be held responsible for the safe condition of the screen and ashpan on their locomotive. A railroad which runs through some of the forest towns in the Catskills was equipped with water barrels at intervals of forty rods, wherever any woods adjoined the right of way, to facilitate the efforts of the section men in extinguishing the flames that start up behind passing trains.

Nevertheless, in times of prolonged drought, even with a well-organized force of patrols on duty, the forests will be in danger, and until some safe motive power is adopted fires from this force may be expected. The recent successful experiment on the New York Central Railroad, in which an electric engine hauled a heavy train at a high rate of speed, leads to the hope that the railroad companies with lines running through the forest districts may be induced to use electric motors and thus eliminate completely this most prolific source of destruction to woodlands.

Reforesting.

But little work was done this year in reforesting, as the appropriation for 1904 did not become available until too late for the spring planting. Still, one of the tracts in the St. Lawrence Reservation, at Cance Point, on the lower end of Grindstone Island, was planted this fall with seedlings of broad leaved species. This tract, which contains 70 acres of cleared land, was set out with plants taken from the State nursery at Brown's Station, in the Catskills. The number of seedlings of each species planted at Canoe Point was as follows:

Red Oak	23,620
Pin Oak	22,300
Chestnut	7,000
Black Locust	3,000
Black Walnut	2,035

In addition there are 6,500 seedlings of white ash and hickory which were left at Brown's Station, as the weather became so inclement that it seemed best to wait until the next spring before setting them out at Canoe Point. For the same reason, 15,115 plants were heeled in at Canoe Point awaiting spring, when they will be set out also, or used for reinforcing any blanks which may be found.

The seedlings were planted at intervals of seven feet each way instead of four as customary in a plantation of conifers, or one that is intended for timber production only. This work was placed in charge of Mr. E. M. Moffett, one of the State Foresters and a graduate of the Forestry School at Biltmore, N. C., where there are good opportunities for studying the technical methods used in making a plantation of hardwoods. Before selecting definitely the site at Canoe Point, Mr. Moffett made a preliminary examination of the soil, which he reported as being of the best quality, proper depth, and well adapted to the growth of the various species which we intended to plant.

In order to protect the plantation from cattle which had hitherto grazed freely on this land, a substantial wire fence, nearly one mile in length, was constructed across the base of the peninsula which forms the Canoe Point tract. The cost of this fence, however, was not taken out of our appropriation for tree planting, but was charged to a special fund which had been provided by the Legislature for the betterment of properties in the St. Lawrence Reservation.

While planting up the land on this tract the attention of the forester was directed to the field mice which were evidently there in dangerous numbers. The plantation was therefore thoroughly "poisoned" by a liberal distribution of a mixture consisting of corn meal, or wheat, and strychnine. Two formulas were used for this purpose:

1. Three quarts of corn meal, one-twelfth ounce of strychnine, one-half pound of brown sugar, and one quart of water.

2. Three quarts of wheat, one-twelfth ounce strychnine, one-half pound brown sugar, and one quart of water.

For such purpose the sugar and strychnine should in each case be first dissolved in the water thoroughly. If wheat is used the grains should be soaked in this mixture two days, after which, the water having been absorbed

it must be dried completely. The wheat is scattered broadcast; and it is claimed that one kernel will destroy a mouse. The meal, however, is said to be the most effective. It should be used while damp, and placed in small quantities — one-half teaspoonful in a place — at frequent intervals in the runways of the mice. At Canoe Point, a light snow having fallen the runways were easily discovered.

These formulas have been used with good success in the large nurseries of R. Douglas' Sons, at Waukegan, Ill., where at one time a loss of $5,000 in white pine seedlings was caused by the depredations of rodents before their presence was discovered.

Another tract was sown with white pine by the seed-spot method. The land selected for this purpose is in Essex county, near the highway running from Lower Saranac Lake to Lake Placid. The ground on this site was so uneven, rough, and overgrown with scrubby brush that the planting of seedlings at regular intervals was not practicable. The seed-spot method consists in breaking up the ground in small circular spots, about two feet wide, and at intervals of eight feet each way, or as near that as the obstacles will permit. A few seeds, ten or twelve, are scattered on the freshly turned ground and lightly covered with earth. When the seedlings thus propagated are two years old they are taken up, with the exception of one which is allowed to remain; the others, so far as needed, are set out immediately in the intervening spaces close at hand, forming thereby a plantation with intervals of four feet each way between the plants. The seed-spot method, owing to its smaller expense, is used also on smooth, level ground, in which case the patches are made at the smaller intervals on the start, thus saving any subsequent transplanting into the spaces.

Another small tract near the Lake Placid road was sown with white pine, scattered broadcast. This method is also preferable on ground where seedlings cannot be set out with advantage, and furthermore, it is the cheapest way to reforest denuded lands. But it has its disadvantages as well; the seeds are often eaten by birds or rodents; and, under the most favorable circumstances, the germination is very apt to be uneven, the seedlings coming up thickly in some places, and scarcely at all in others.

Still, the broadcast sowing of native spruce, in 1902, under the poplar groves near Aiden Lair, in Essex county, was successful in every respect.

Forester Knechtel, who did this sowing, was instructed to make a careful examination of this ground last spring, and make a report on the result. He found the surface under the young poplars — trees twenty to twenty-five feet high — thickly covered with little spruce seedlings, and this report was so encouraging that broadcast sowing will be undertaken on a large scale as soon as we can gather a supply of seed from our native spruce for that purpose. The experiment at Aiden Lair indicates that the numerous areas of poplar forest which now cover many of the old burns can be successfully underplanted with red spruce.

Saranac Nursery

The work on the construction of a nursery at Saranac Inn R. R. Station, Franklin county, which was suspended in 1903 through lack of an appropriation that year for reforesting, was resumed last spring. Seed beds for various coniferous species were then made and the seed put in. In order to gain time one-half of the nursery area was set out with two-year old seedlings of white pine, Scotch pine, and Norway spruce, planted in beds four feet wide and fifty feet long. For this purpose 125,000 seedlings were purchased from commercial nurseries in Illinois, at prices varying from $2.50 to $5.50 per thousand plants. The white pine seedlings cost, on an average, $4.62½; the Scotch pine, $3.00, and the Norway spruce $2.50 per thousand.

As the present intention is to use the Saranac nursery for a supply of four-year-old transplants, these seedlings will have to remain in the beds two years, and will not be available for field planting until the spring of 1906.

In order to have, in time, a supply of four-year-old transplants each year, one-half of the nursery area was allowed to lie fallow, with the intention of filling it with two-year-old seedlings this coming spring. After that the seed beds will enable us to dispense with further purchases of stock for the nursery. The portion which lay fallow was planted with a crop of buckwheat, which was plowed under in the fall, and the soil was further enriched with a light covering of black muck and some compost taken from a large pile kept on hand at the nursery for this purpose.

A substantial paling fence now surrounds the enclosure, and a tool house

was built near the north gate. A hydraulic ram was purchased and placed near by, just below the dam on the outlet of Little Clear Pond. From this ram water is forced through a one and one-quarter inch pipe up to a large tank, well housed, and situated on the side of the adjoining hill, forty-three feet above the nursery. The tank has a capacity of 5,000 gallons. A two-inch main leads from the tank house to the distributing pipes and hydrants in the nursery. With this arrangement a line of hose, with a spray nozzle, can be attached readily to a hydrant, and, whenever it becomes necessary in a dry time, the beds can be sprinkled or showered without any further expense or inconvenience. The paling fence, tool house, and tank house were given two coats of green paint. The stock in the beds is in excellent condition, the plants are in thrifty growth, and the Commission has reason to be well satisfied with the appearance of the nursery.

Seed Gathering

The year 1904 was a seed year for white pine in New York, and so arrangements were made for gathering a supply, as this species produces seed only at intervals of four or five years. An examination of the pines in Northern New York was made by our foresters last year, when it was found that the little cones, which require two years in maturing, were forming to an extent that indicated a seed year for 1904. As the native red spruce and Norway pine did not bear cones this year the work of seed gathering was confined to white pine.

Forester Pettis, who was in charge of this work, after a prolonged examination of the pine in various localities, selected the woods in the vicinity of Willsboro, Essex county, as the best field for operations. An agent for some European seed firms was already there with a large force of men and boys engaged in collecting white pine cones.

Work was commenced early in September, before the scales on the cones had opened, and a supply was gathered between the 6th and 18th of that month. The men and boys employed were paid 30 cents per bushel delivered in sacks at Willsboro, at which price they made very good wages. At the start only 25 cents was paid, but as other parties on the ground were offering 30 cents per bushel, Mr. Pettis was obliged to pay the same.

The cones were dried and threshed in a barn near Willsboro, rented temporarily for this purpose, after which the seeds were cleaned and winnowed in a fanning mill of the kind used by farmers.

A bushel of white pine cones yields on an average a little over one pound of clean seed, which contains about 29,500 grains. As the foresters received 500 bushels of cones they secured over 500 pounds of clean seed. This supply cost 47½ cents per pound, not including the foresters' expenses or the purchase of some material which was charged to the permanent plant, and is available for future work of this kind. As the market price of white pine seed runs from $2.50 to $4.50 per pound, according to the absence of a seed year and its scarcity, it will be seen that the work was timely and economical.

Part of this stock is needed for the seed beds in our nurseries during the years that must intervene before another supply can be gathered, and the remainder will be used for broadcast sowing in the field or for seed-spot planting. Next year the red spruce will bear cones, and the seed gathering that season will be directed to that important species.

St. Louis Exposition

An exhibit was made by this Commission at the Louisiana Purchase Exposition, held at St. Louis, Mo., during the past year. The exhibit was made, as I understand it, in compliance with an urgent invitation from the State Board of Commissioners for the fair, who generously set apart out of their appropriation the sum of $18,000 for this purpose.

The work of collecting and preparing articles suitable for a display was commenced in January, and on May 1st, the opening day of the Exposition, the exhibit was completely installed and ready for the inspection of visitors. The collection was placed in charge of Mr. A. B. Strough, of this Department, who went to St. Louis in April, and attended to the unpacking and arrangement of the various articles. He remained there during the entire time, and supervised the boxing and shipment of the goods in December. Much of the success of the exhibit is due to his intelligent management and diligent attention to every detail connected with its installation. The fair closed December 1st, after which the greater part of the material was

shipped to Portland, Oregon, where it will be placed on exhibition at the Lewis and Clark Exposition in 1905.

Each department of the New York Forest, Fish and Game Commission was represented in its exhibit at St. Louis. That of the Forestry Department was as follows:

1. Native woods of New York, embracing all of the 91 species of trees indigenous to the State,* two specimens of each, showing on different sides a rough, planed, oiled, and varnished surface, each specimen having a printed label showing both the common and the botanical name.

2. Large photographs — 18 x 24 inches — of each tree, with two views of each species, one showing the tree in full leaf, the other showing the same tree when leafless, thus affording an opportunity for studying its habit and the arrangement of limbs. Attached to each photograph were specimens of leaf, flower, and fruit.

3. Entomological Exhibit. A large table with glass show cases containing a collection of insects injurious to forest trees, mounted so as to show the insect at work on leaves or wood. Prepared expressly for this exhibit by Prof. E. P. Felt, State Entomologist.

4. Large thick "sheets" of wood pulp, ready for a paper mill, made from different species of trees, the products of both chemical and mechanical mills; also, utensils of various kinds, pails, tubs, etc., made of wood pulp or indurated fibre.

5. Complete collection of forest by-products, shown in glass jars of uniform size arranged on a stand with circular shelves; 28 different kinds,— wood alcohol, acetic acids, acetates of lime, tannic acids, dry pulp, lampblack, spruce gum, maple sugar, etc.

6. Complete collection of tree seeds from species indigenous to New York, shown in glass jars of uniform size arranged on a stand with circular shelves.

7. Scientific instruments and tools used in forestry work and in lumbering operations.

8. Sections of white pine and red spruce showing by the annular rings the maximum rate of growth.

* Specimens of nine introduced species were also shown in this collection.

9. Photographs of forest scenery; also, of hotels in the Adirondack and Catskill regions indicating the summer hotel business in these forests.

10. A small forest tree nursery located outside the Forestry Building, near its principal entrance, in which was shown the process of raising trees from seed, transplanting the seedlings into nursery beds, and thence into a miniature plantation. Young plants of the principal species raised in forest tree nurseries, coniferous and broadleaved, were exhibited in seed-beds; also, in beds of four-year-old transplants, and in a plantation of six-year-old trees set out at spaces five feet apart. The germination in the seed beds was very satisfactory, the seeds having been planted early in the spring, before the Exposition opened. The seedlings and transplants maintained a thrifty condition, and made the usual growth during the summer. This nursery exhibit, under the management of Forester Knechtel was a gratifying success, attracting the favorable attention of the foresters, nurserymen, and botanists, who visited it in large numbers. At the close of the Exposition the plants were taken up and shipped to the Saranac Nursery.

The Fish and Game Department of the Commission was represented by a collection of mounted specimens showing the fur, fin and feather of New York. The display of mounted fish, including all the species found in the waters of this State, and made under the direction of Mr. John D. Whish, Secretary of the Commission, was shown in twelve cabinets constructed for this purpose. The specimens of animals and birds collected by Mr. Strough and arranged attractively by a taxidermist, were exhibited by placing the small birds in cabinets and the large ones on trees, while the larger animals — bear, wolf, panther, deer, fox, otter, beaver, etc.— were placed in suitable positions at convenient points within the enclosure. The mounted wolf was the last of its species in New York, and the same is probably true of the panther shown in this collection. An attractive feature of the fish and game exhibit was a typical hunter's cabin of the better class, built of logs with a roof of spruce bark. This building was erected first in the Adirondacks at Big Moose, after which it was taken down, the logs numbered, and shipped to St. Louis, together with the rustic fence of white cedar which enclosed the space allotted to the Commission. The furniture in the cabin, including a bed and lounge, was of a handsome and

appropriate design, made in the Adirondacks by an expert in that class of work. The floor was covered with rugs of various furs, and the walls, decorated with gay-colored blankets and hunting trophies, were also hung with gun racks, fishing tackle, paddles, smokers' materials, and many articles that would attract the eye of a sportsman. Outside the cabin lay a fine specimen of an Adirondack guide boat, with its cane-bottomed seats, oars, and paddle. This cabin made a convenient office for the official in charge of the New York exhibit, and the seats on the porch were occupied continually by tired but admiring visitors.

The Shell Fish Department, through its superintendent, Mr. B. F. Wood, displayed in cabinets an interesting and instructive collection of various mollusks found in the marine waters of the State, and the parasitic enemies that prey upon them. This exhibit served to call attention to the great business interests dependent on the oyster fisheries in New York waters, and the connection of the Commission with this industry.

In planning the forestry exhibit, the intention was to make it instructive, rather than spectacular. It was gratifying to note the interest which some of the foreign exhibitors took in the exhaustive collection of native woods, some of them, noticeably the Japanese and Germans, evincing their appreciation by copying the printed labels on the 100 species. A foreign entomologist spent the best part of several days in studying the large collection of insects injurious to forest trees, during which he also copied all the labels and printed explanations found there. The forester in charge of the outdoor nursery was in frequent demand by visitors who wanted detailed information in regard to the technique of the silvicultural work displayed in that enclosure.

In recognition of the attractive and comprehensive character of the entire exhibit the jury of awards granted three grand prizes, three gold medals, and four silver medals. The superintendent of forests was awarded a gold medal as collaborator, and the gentlemen who assisted in the preparation of the collection received a silver medal each.

Annual Lumber Production

Although the cutting of timber on the Forest Preserve is prohibited by law, lumbering operations on private lands is carried on throughout the Adirondack wilderness and on a scale more extensive than ever before. In order that there may be a better understanding as to forestry conditions in this State, and the extent to which its timber resources are annually decreasing, the law requires that the annual report of the Commission shall contain a statement showing the amount of timber cut the previous year in the Adirondack and Catskill forests for all purposes except fuel.

There are 491 firms or individuals engaged in manufacturing lumber, pulp, excelsior, staves, heading, wood acid, shoe lasts, furniture, etc., that obtain their stock of raw material from the Adirondack and Catskill forests. It does not seem necessary to publish here the lengthy tabulations showing the detailed returns made to this Department by the various manufacturers, as a statement of the aggregate amount of each species consumed will probably suffice. A consolidation of the figures as reported from the office books of each firm or individual gives this result:

ADIRONDACK FORESTS — 1903.

	FT. B. M.
Spruce, for lumber	159,764,700
Hemlock, for lumber	53,384,050
White pine, for lumber	28,906,000
Hard woods, for lumber	47,412,090
Pulp wood, 481,876 cords	289,125,600
	578,592,440

	PIECES.
Shingles	31,516,450
Lath	52,659,692

Catskill Forests — 1903.

		FT. B. M.
Spruce, for lumber		1,451,910
Hemlock, for lumber		15,732,340
White pine, for lumber		7,669,400
Hard woods, for lumber		21,273,750
		46,127,400
Woods used for:		
Wood acid	106,648 cords	
Excelsior	3,116 cords	
Wood pulp	7,100 cords	
Fuel in brick kilns	6,914 cords	
	123,778 cords	74,266,800
Furniture		301,120
		120,695,320

	PIECES.
Shingles	10,259,660
Lath	5,261,000
Railroad ties	26,040
Heading	5,946,800

Summary.

Adirondack forests	578,592,440
Catskill forests	120,695,320
	699,287,760

The output of the principal lumber firms was as follows:

	FT. B. M.
Finch, Pruyn & Co., Glens Falls, N. Y.	22,635,000
Norwood Mfg. Co., Tupper Lake, N. Y.	18,401,450
A. Sherman Lumber Co., Tupper Lake, N. Y.	13,694,000
Moose River Lumber Co., McKeever, N. Y.	13,541,000
*Brooklyn Cooperage Co., Tupper Lake, N. Y.	14,150,000

* All hardwoods.

The amount consumed by the principal pulp mills was:

	CORDS.	FT. B. M.
International Paper Co.	127,307	76,384,200
Hinckley Fibre Co.	35,000	21,000,000
St. Regis Paper Co.	29,128	17,476,800
J. & J. Rogers Co.	26,107	15,664,200
Union Bag & Paper Co.	26,000	15,600,000

The reports from the pulp mills were confined to the consumption of wood taken from the Adirondack forests, and do not include stock shipped to the mills from Canada. The large amount returned by the International Paper Company represents the combined consumption of eleven mills, viz.:

MILL.		CORDS.
No. 1	Glens Falls	15,770
No. 2	Fort Edward	11,815
No. 3	Palmer Falls	11,608
No. 6	Niagara Falls	69
No. 14	Lake George	1,933
No. 16	Ontario	4,949
No. 17	Piercefield	15,603
No. 21	Lyon Falls	10,718
No. 22	Cadyville	25,545
No. 29	Watertown	15,263
No. 31	Woods Falls	14,034
		127,307

On a basis of 600 feet to the cord, this would be equivalent to 76,384,200 feet, B. M.

Of the 289,125,600 feet consumed in the manufacture of wood pulp, about four-fifths was spruce, the remainder consisting of balsam, hemlock, pine, and poplar. It is impossible to state the exact proportion of spruce, because many of the mills were unable to classify their returns in this respect.

From the previous statements of forest production in the Adirondacks, as published annually in my reports, it will be seen that the consumption of wood for pulp has increased from 51,966,262 feet in 1890 to 289,125,600

Photo. A. Knechtel.

BANKING GROUND FOR LOGS AT ELM LAKE, IN THE ADIRONDACKS.

Photo. A. Knechtel.

LOG HAULING ON A STEEP GRADE.

SLEIGH TRACK ON HILL COVERED WITH STRAW TO ACT AS A BRAKE ON THE SLEIGH.

feet in 1903; and the hard-wood output from 5,835,844 feet in 1890 to 47,412,090 feet in 1903. To the person who is interested in studying the forestry problem in this State, these figures are full of meaning.

The large output for 1903 was due in a considerable degree to the forest fires of that year, which killed the timber on large areas without injuring it materially. This dead timber, if cut within a year, was available for both lumber and wood pulp. If allowed to stand the spruce would deteriorate the second year, and become worthless in three years. In order to save this timber and that of other species, the owners cut what they could this last season. Fortunately there was a good market and a brisk demand for all the lumber and pulp wood produced, and hence the loss by the great fire of 1903 was correspondingly decreased.

Constitutional Amendment

It is proposed to amend the forestry clause in the State Constitution so as to provide thereby that lands in the Forest Preserve which are situated outside the boundaries of the Adirondack and Catskill Parks may be sold and the proceeds applied to the purchase of lands within the parks. This amendment has already passed the Legislature at its last session, and must be passed again by the new Legislature this coming winter, after which it must be submitted to the people at the next election, when, if voted on favorably, it will become a law.

In order that the question may be discussed intelligently, some information seems necessary as to the extent and character of these outlying lands. To this end I would respectfully submit here some statistics relating to these important points. A careful compilation from the printed volume containing the official list of lands in the Forest Preserve, lot by lot, shows that there are 1,037 parcels or lots situated outside the two parks, and that their combined acreage by counties is as follows:

Adirondack Counties.	Acres.	
Clinton county	21,289	
Essex county	10,652	
Franklin county	15,172	
Fulton county	23,484	
Herkimer county	6,594	
Lewis county	4,531	
Oneida county	6,651	
St. Lawrence county	3,919	
Saratoga county	9,472	
Warren county	16,316	
Washington county	2,144	
	120,224	
State Prison Tract:		
Clinton county	14,347	
		134,571
Catskill Counties.		
Delaware county	6,735	
Greene county	171	
Sullivan county	772	
Ulster county	2,349	
		10,027
Total		144,598

From an examination made by our foresters, these lands have been classified as follows:

Adirondack Lands.	Acres.	
Virgin forest	17,966	
Lumbered forest	45,424	
Second-growth forest	18,932	
Waste	7,258	
Denuded	13,584	
Burned	13,708	
Wild meadows	540	
Water surfaces	1,064	
Improved land	1,748	
		120.224

CATSKILL LANDS.

Forest	1,961	
Lumbered	4,144	
Waste land	2,699	
Denuded	322	
Burned	386	
Cleared	264	
Improved	251	
		10,027

The terms used in the Adirondack classification mean that *Virgin Forest* consists of the primitive growth in which no timber cutting or lumbering has been done; *Lumbered Forest* is one in which the lumbermen have removed the soft woods down to ten inches diameter on the stump, leaving the land under a forest cover to hard woods and small evergreens;* *Second-growth Forest* stands for tracts that were cut, burned, or cleared many years ago, since which the land has reforested itself with trees 25 to 40 feet high; *Waste land* means tracts covered with a scrubby growth of dwarfed trees, bushes, and briers; *Denuded land* consists for the most part of abandoned clearings, or of areas covered with ferns, huckleberry bushes, or other small growth; *Wild Meadows* are clearings on which wild hay is cut each year and includes beaver meadows; *Improved land* is a term used by assessors to denote farms or fields on which crops are raised or have been recently cultivated.

Most of the lots are in scattered situations, a long distance from the park, and cannot be properly watched or cared for without going to considerable expense. If these outlying lands could be sold the proceeds would purchase an equal or greater acreage within the park, where the holdings would be better located, would help to consolidate tracts already owned by the State, and would be better adapted to forestry purposes. The timber lots, though widely scattered and small in area, would, when duly advertised, bring large prices, on account of their accessibility; and even the denuded and burned tracts could be sold at fair prices for farming purposes. In short, it is better to transfer this acreage to territory within the parks.

* On private lands the lumbermen now take the smaller softwoods also, cutting down to a diameter of eight inches or less.

Adirondack Map

Your attention is respectfully called to the need of another edition of the Adirondack map, for which there has been a large and constant demand since its first issue, fifteen years ago.

This map is indispensable in the work of the Forestry Department, as it is the only one showing the landed allotment of that entire region. The foresters and fire-wardens find it convenient, absolutely necessary, in locating the State lots and acquiring a knowledge of their boundaries in order to protect and manage these forests properly; and without its aid the Purchasing Board would find no small difficulty in transacting the business incidental to buying lands.

The map now in use answered its purpose very well at the time of its first issue, because at that time there was no map of the entire region except the small pocket editions printed by various persons for the use of tourists. It was made under great disadvantages, by compiling the maps of the various townships which had been made by the old surveyors, some of them by Jessup, Richards, and others, over a hundred years ago. These maps, old or new, were drawn to a different scale for the most part and had to be reduced to a uniform scale before they could be united in one sheet. The originals were replete with topographical errors, as the surveyors, in many instances, merely ran out the boundaries of the townships, which are about six and one-half miles square,* after which they entered on their map the position of the lakes, streams, and roads as best they could, generally by guesswork or hearsay. In only a few instances are our original township maps correct in their topography. Still we availed ourselves of the information found in the partial and incomplete sheets known as the Butler Map (1879), the Jones Map (1851), Burr's Atlas, a collection of county maps made in 1823, and other similar sources. Utilizing this data a map was constructed which, despite its inaccuracies, has answered its purpose very well up to the present.

Since then, however, through the excellent and accurate work done by

* The townships in the Totten & Crossfield Purchase, 50 in number, are mostly 6 by 6½ miles; the townships in the Macomb Tract are somewhat larger; and in the Old Military Tract they are from eight to ten miles square.

the United States Geological Survey, we have come into possession of a large amount of valuable data relating to the topography of the Adirondacks, which is available for a new map. I would therefore respectfully recommend that our present sheet be discarded and that a new map of the Adirondack region be made in which can be incorporated the valuable data contained in the sheets of the recent Geological Survey. To this end I would suggest that the Commission ask the Legislature to appropriate at its next session the sum of $900, or so much as may be necessary, to pay a competent draughtsman to make a new map to be used by the engraver before printing the next edition.

In answer it may be pointed out that the Geological Survey has not yet completed all of its Adirondack sheets. But this need not necessarily delay the issue of our new map. The triangulation of the unsurveyed squares has been made and this will enable us to block out our map in squares that will be geographically correct. Having done this, we can fill in the topography from the sheets of the Geological Survey so far as completed. The remaining squares can be filled in from such data as we have, which can be corrected, if necessary, from time to time in later editions from the sheets subsequently furnished by the survey.

With a map thus constructed we can overlay it with the lines of the landed allotment and the different lots or parcels can be accurately located by noting on the ground where the blazed lines and corners coincide with topographical points, thus " tying up " our allotment to the distinguishing features shown on the United States maps. Having done this, a forester, map in hand, can go direct and without loss of time to the corner of any lot or township on which the blazed lines or boundary marks have not been obliterated.

WILLIAM F. FOX,
Supt. of State Forests.

ALBANY, N. Y., *December* 31, 1904.

Report of Superintendent of Forests for the year 1905

Hon. James S. Whipple, *Forest, Fish and Game Commissioner:*

SIR.—In compliance with a requirement of the State Forestry Law, I respectfully submit herewith my annual report on the forest fires which have occurred in the Adirondack and Catskill counties during the calendar year just past. In addition, I submit for your consideration a report on various other matters incidental to the exercise of the powers and duties conferred on this Department.

Forest Fires

The forest fires were comparatively few in number, and the damage, in view of the losses in other years, was slight. The number of fires, including incipient ones which were quickly extinguished, amounted to 79 in the Adirondacks; and 47 in the Catskills. In most of these, little or no damage was done to standing timber, the fire running only in the dead leaves on the ground, or over some open pieces of pasture and waste land. The causes as reported by the fire-wardens were as follows:

Railroad locomotives	31
Tobacco smokers	18
Hunters	10
Fishermen	2
Clearing land	8
Burning rubbish	3
Burning brush	1
Burning grass	1
Buildings on fire	6
Incendiary	5

Berry pickers	2
Log drivers' camps	2
Coffee fires	2
Bonfire	1
Children at play	1
Imbecile	1
Sparks from sawmill stack	1
Cause unknown	31
Total	126

The fire-wardens in stating the origin of the fires, as required in their reports, merely expressed an opinion in most instances as to the probable cause, the evidence not being sufficient to warrant a positive statement, or to secure a conviction in case a prosecution was attempted.

The total area of timber lands burned over amounted to 2,670 acres in the Adirondacks; and 2,125 acres in the Catskills. In all, the damage to standing timber was estimated in the reports of the fire-wardens at $3,895. That the loss on these areas was no greater was due to the fact that most of the fires were "surface fires," as they are called, which ran through the woods on the ground without scorching the trunks of the trees sufficiently to kill them. The loss in State timber was slight, amounting to $60 only.

Although the past season was, for the greater part, a rainy one, there was a dry spell in the spring, and, also, one in the fall, during which the conditions throughout the Adirondack and Catskill woods became extremely dangerous, especially along railroad lines. Most of the fires reported, as shown by the dates, happened at these times, and had it not been for the activity and efficiency of the fire-wardens in their respective districts the loss in timber would have been serious.

It may be interesting to note the months in which most of the fires occurred, as the records, in this respect, indicate clearly the dangerous periods of the year, and justify fully the enactment of the law which prohibits the burning of fallows in forest towns during these months. The ones in which the fires occurred and the number in each were:

March	1
April	51
May	37
June	4
July	6
August	1
September	1
October	15
November	10
Total	126

There was an encouraging decrease in the violations of the law which forbids the burning of fallows or brush during certain periods in the spring and fall. The offenses in this respect were 13 in number, each of which was promptly prosecuted by the chief fire-warden as soon as the case was reported. In 12 of these cases the offender was arrested and taken before a justice of the peace who imposed a fine, the penalties amounting in the aggregate to $190, not including costs, which were also paid by the defendants. One action is still pending and awaiting trial.

But in the two previous years there were 85 violations of this section of the forest law, each of which was successfully prosecuted, the fines imposed and collected amounting to $2,806.70. Over 5,000 notices, printed on cloth, containing a copy of the law defining the close season are annually posted throughout the forest towns. Still, there were so many of the farmers or other residents who paid no attention to these warnings, or who openly defied this law, that a vigorous prosecution of all offenders became necessary to secure a proper respect for its provisions. The small number of violations during the last year indicate that the lawless element in the resident population has become convinced at last that the law must be observed.

As usual the greatest number of fires from any one source were started by live coals dropped from the ashpans of railroad locomotives, or sparks from the smokestacks. Some of the railroad officials were evidently careless and indifferent in regard to the damages thus caused, despite their professions to the contrary. On the other hand, it is pleasant to note the

efforts made by the authorities in charge of the Adirondack Division of the New York Central to prevent forest fires along that line. Twice during the year, in the spring and in the fall, an emphatic order was issued to all trainmen, directing them to take every precaution against fires, and special instructions were given to the engineers and firemen, notifying them that all ashpans on the engines must be in good order before leaving terminal stations, and that the back dampers must be kept closed; also, that any defects in engines that might permit the escape of sparks or coals were to be reported to the engine foreman. It was further ordered that if a fire was discovered at any point along the line, the section men must be notified at once and the trainmaster's office also.

Some woodland fires occur every year in one or another of the agricultural counties outside the Adirondack and Catskill districts, especially on Long Island. But, in these places a conviction for a violation of the fire law, a duty which devolves upon the town supervisor, is more difficult to obtain than in the sixteen counties which contain the Forest Preserve. The *Corning Democrat*, in its issue of October 5, 1905, has the following item indicating the views which a jury often holds in these cases:

"In the case against Charles Sabin, charged with wilfully and negligently refusing to extinguish a forest fire, the jury returned to the courtroom for further instructions. They wanted to know what the court would do with the defendant if the jury found him guilty. The judge very properly refused to enlighten the jurymen on that point and sent them back to deliberate. Later the jury returned a verdict of not guilty, county to pay the costs."

Trespasses on State Lands

At the last session of the Legislature, at the suggestion of the Governor, an amendment to the Forestry Law was passed, placing the care and custody of the Forest Preserve in the hands of the Superintendent of State Forests, and directing the inspectors, game protectors, and fire-wardens to report all trespasses directly to him, thereby restoring the powers and duties devolved upon that office prior to 1895. For the last ten years the work belonging to the reporting and suppression of trespasses on the Forest Preserve was entrusted by law to another department of the Commission.

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Another and an important clause in the amendment referred to, provided that the fire-wardens should report any trespass occurring in their respective towns or districts, and that upon conviction of an offender the fire-warden reporting the case should receive as a reward for his services a share of the money collected for the penalty, this share being the same as already fixed by law. Hitherto, the fire-wardens had ceased to furnish information of timber cutting on the preserve, alleging in excuse of such nelgect that the law did not require them to do it. They explained further that when they had done so the reward was given to some other official who took charge of the case, and that as they served without pay there was no inducement to turn informer on their neighbors But since the enactment of this amendment they have expressed a willingness to watch the State lands with regard to trespasses as well as fire, and some of them have already rendered valuable service in the detection of timber thieves. As there are 746 town and district fire-wardens in the Adirondack and Catskill counties the enlistment of their services in the suppression of timber stealing will add materially to the efficiency of the Department.

The amendment was signed by the Governor and became a law, April 22, 1905. (Chapter 285, Laws of 1905.) Arrangements were immediately made by which every township or locality where a trespass might occur was thoroughly examined by the inspectors or other officials. As the information thus obtained and the extraordinary developments that resulted are already known to you in detail, any further reference is unnecessary here. Suffice it to say that the timber cutting was promptly stopped, and that in each case a prosecution for the extreme penalty of the law was begun immediately. Through the rigorous enforcement of severe penalties the petty thieving in certain other localities has been suppressed also. As a result of the work done since last April, there is no timber cutting now on the Forest Preserve, aside from a few tracts on which there was a timber right at the time when the land was purchased by the State.

Some trespasses may occur from time to time which are not intentional, owing to a lack of boundary marks or because of disputed lines. The Adirondack townships were surveyed and allotted from 70 to 120 years ago, and in most cases the blazed marks on the line trees are overlaid with several inches of wood, making it difficult for anyone to find them unless

he is an experienced surveyor, well skilled in woodcraft. But this difficulty is, comparatively, a small one. In many instances two or more lines have been run and blazed many years ago, and at this late day it is not always easy to determine the correct one. Furthermore, the boundaries of many townships or interior lots have been obliterated by fire or axe, and the true line can be established only after a long and expensive survey. In order to guard against any timber cutting on the Preserve, unintentional or otherwise, the Department has incurred heavy expenses this last year in surveying and re-establishing the boundary lines on all State lots that adjoined lands on which lumber operations were being carried on.

Area of the Forest Preserve

During the last year a part of the office force has been engaged in compiling a list of the different lots and parcels of land in the Forest Preserve, as taken from the official records on file in the Land Department of the Comptroller's office. An edition of 500 copies of this list was printed as a supplementary volume of the last report. As this book contains no reading matter, or little of interest to the general public, the edition was limited to such number only as might be necessary for use of the Department officials, fire-wardens, and foresters, with some additional copies for the Comptroller's office and to meet a demand from people who own adjacent lands.

Though of little or no interest to the general public, it is the most important and valuable publication issued by this Department. It is the basis of the entire landed business of the Commission. In this printed list will be found, convenient to hand, some definite information as to the various lands owned by the State in the Forest Preserve counties, the average of each lot, and its location. The source of title is also stated—whether acquired at tax sale, by purchase, foreclosure of mortgage, or sale of bonded lands. If acquired by tax sale, the year in which the sale was held is given; and, if by purchase, the year in which the property was bought.

From these schedules the draughtsman obtains the information which enables him to show, in color, the State lands on the Adirondack and

Catskill maps, and to indicate definitely the location of each one of the 6,262 separate parcels of land which constitute the Forest Preserve. With this printed list of lots each forester, inspector, and fire-warden knows the location of the lands which are in his care and custody, and the property that requires his particular supervision.

In section 216, chapter 20, Laws of 1900, the Preserve is defined as follows:

"The Forest Preserve shall include the lands owned or hereafter acquired by the State within the county of Clinton, except the towns of Altona and Dannemora, and the counties of Delaware, Essex, Franklin, Fulton, Hamilton, Herkimer, Lewis, Oneida, Saratoga, St. Lawrence, Warren, Washington, Greene, Ulster and Sullivan, except

1. Lands within the limits of any village or city, and

2. Lands not wild lands acquired by the State on foreclosure of mortgages made to loan commissioners."

The second exception renders it difficult in some instances to determine whether a parcel of land belongs to the Preserve. A farm property, sold under foreclosure, may contain a large tract of woods or "wild land" as well as cleared or cultivated ground. The question then arises whether the portion containing the woodlands does not belong to the Preserve.

It is not always easy to draw the line between wild land and pasture. Then, again, some of the areas acquired by the State under foreclosure of mortgages made to loan commissioners are now abandoned farms that have grown up to brush or trees, and which in a few years will become second-growth forests. For these reasons several lots obtained through foreclosures are included in the list.

The list contains, also, some lands acquired through tax sales, the title to which may be doubtful, owing to errors on the part of the assessors or tax collectors. These errors had not been discovered at the time of the tax sale, and so the title to the lands passed nominally to the State. As these lots are entered upon the books of the Comptroller as State land, it becomes necessary to include them here as part of the Forest Preserve. In fact, these lands with their disputed titles cannot be stricken off the schedule except by order of the courts or action of the Legislature.

The large tract in Franklin county, bought by the Forest Preserve

Board for the use of the State College of Forestery, is included here as a part of the Forest Preserve in accordance with the law which provides that it "shall include the lands owned or hereafter acquired by the State." The Commission, however, has excepted this tract in its administrative work, for the land was deeded in trust to Cornell University for thirty years, during which time the university, as provided by law "shall have the title, possession, management, and control of such land," for the purpose of maintaining the State College of Forestry.

A list of the various parcels in the St. Lawrence Reservation or International Park is appended for convenient reference, but it is not included in the schedules of the Preserve; for some of these reservation lots are situated in Jefferson county, which is not one of the sixteen counties mentioned in the law constituting the Forest Preserve. These lots, which were purchased by the State in 1897 and 1898 through a special appropriation for that purpose, are situated on various points or islands in the St. Lawrence river in the vicinity of the Thousand Islands. They are under the care and control of the Commission, and though not wild or forest lands are properly a part of the Preserve.

For further reference and information there is appended also a list of the lands owned by the State in the towns of Altona and Dannemora, Clinton county. In the forestry law these lands are excluded from the Forest Preserve, it being understood at the time this law was framed, in 1885, that the timber on them would be needed for the use of the State prison at Dannemora.

It is doubtful whether some of the State lands in the adjoining towns are properly a part of the Forest Preserve, owing to a provision in section 67, chapter 208, Laws of 1894, which reads as follows:

"All uncultivated lands belonging to the State of New York, or which may hereafter become the property of said State, and which shall be situated within ten miles of the Clinton prison, shall be withdrawn from sale, and shall be retained by the State for the use of said prison." But when the Forestry Law was codified and re-enacted in 1900, the section defining the Forest Preserve made no exception of lands within ten miles of the prison, and excluded only the State holdings in Altona and Dannemora.

The acreage of the Forest Preserve by counties is as follows:

ADIRONDACK PRESERVE.

COUNTIES.	NUMBER OF PARCELS.	ACQUIRED AT TAX SALES.	ACQUIRED BY PURCHASE.
Clinton	110	$15,962 18	$3,979 93
Essex	1,208	189,684 06	50,919 44
Franklin	419	93,995 47	67,157 53
Fulton	182	22,710 00	
Hamilton	2,308	255,801 66	317,709 53
Herkimer	535	20,891 59	123,512 39
Lewis	49	4,412 25	
Oneida	82	2,430 19	
St. Lawrence	102	33,619 44	
Saratoga	92	10,402 65	
Warren	596	66,219 16	49,224 34
Washington	20	1,081 00	.....
Totals	5,703	$717,209 65	$612,503 16

COUNTIES.	MORTGAGE FORECLOSURES.	RESALE OF BONDED LANDS.	TOTAL ACRES.
Clinton	$123 75	$363 14	20,429
Essex	819 50	2,105 00	243,528
Franklin	139 00	1,060 00	162,352
Fulton	455 00	105 00	23,270
Hamilton	68 81	2,520 00	576,100
Herkimer	728 02	.....	145,132
Lewis	107 75	.....	4,520
Oneida	3,616 35	646 46	6,693
St. Lawrence	616 56	.....	34,236
Saratoga	1,242 35	.....	11,645
Warren	.....	1,739 50	117,183
Washington	48 00	1,063 00	2,192
Totals	$7,965 09	$9,602 10	1,347,280

Catskill Preserve.

COUNTIES.	NUMBER OF PARCELS.	ACQUIRED AT TAX SALES.	ACQUIRED BY PURCHASE.
Delaware	95	$12,416 00	.....
Greene	50	1,059 54	$4,418 89
Sullivan	14	825 25	4 75
Ulster	400	36,999 10	34,121 23
Totals	559	$51,299 89	$38,544 87

COUNTIES.	MORTGAGE FORECLOSURES.	RESALE OF BONDED LANDS.	TOTAL ACRES.
Delaware	$415 00	.....	12,831
Greene	262 07	$311 50	6,052
Sullivan	.....	.....	830
Ulster	1,817 30	57 37	72,995
Totals	$2,494 37	$368 87	92,708

Summary.

Separate Parcels.

Adirondacks	5,703
Catskills	559
Total	6,262

Acreage.

Adirondack counties:		
* Within Adirondack Park	1,228,357	
Outside Adirondack Park	118,923	
		1,347,280
Catskill counties:		
* Within Catskill Park	82,652	
Outside Catskill Park	10,056	
		92,708
Total State Ownership		1,439,988

*Does not include entire area within the park, as the State has acquired at present only a part of the territory.

SOURCES OF TITLE.

Lands purchased prior to 1897	$151,451 00	
Lands purchased since January 1, 1897	499,597 03	
		$651,048 03
Mortgage foreclosures		10,459 46
Resale bonded land		9,970 97
Tax sales		768,509 54
Total Forest Preserve		$1,439,988 00

This acreage is constantly increasing through the purchases of the Commission. In fact, it is considerably greater at this date than the above figures indicate, owing to lands that were purchased but not conveyed at the time these schedules were completed.

It will be noticed on referring to this land list that one column is set apart in order to show the source of title to each lot or parcel. From the data in this column it appears that of 768,509 acres acquired through tax sales, the title to over three-fourths of the lands thus obtained came through the sales of 1871 and 1877. The lands acquired at these sales were for the most part covered with a virgin forest in which no lumbering had been done. The greater part of the lands acquired by the subsequent sales were what is known as lumbered lands, although on a large portion of them the cutting had not been very close. On this latter class of lots none of the hardwood had been taken, and the softwoods had not been cut below 10 inches. By the tax sale of 1895 only 39,564 acres were acquired; and in the sale of 1900 the acquisition from this source was reduced to 7,202 acres, nearly all of which consisted of lands situated outside the Adirondack Park. The Comptroller held another tax sale in December of this year (1905); but it is doubtful if any land will be acquired from this source that is situated within the park boundaries. Any further extension of the Forest Preserve, aside from a few small, worthless lots, will have to be made through the medium of purchase by the State.

As previously stated here the Forest Preserve consists of 6,262 separate lots or parcels of land, mostly of 160-acre lots. Some tracts were surveyed out in parcels of 200 acres each, and some townships were subdivided

into mile square lots. Some townships containing 30,000 acres are merely quartered. And so the lots vary from quarter-sections of 40 acres to quarter-townships of 7,500. But, whether small or large, each one of these 6,262 parcels of State land in the Forest Preserve has its own surveyed boundary, stands on its own title, and is a distinct, independent piece of real estate. Several of these lots, when purchased, may be conveyed to the State in the same deed; but one does not have to go back very far in the abstract of title before there is a divergence in the line of ownership. Your attention is thus called to the large number of separate properties in order to give a better idea of the work necessary in keeping a proper record of all this real estate and protecting the various titles.

Adirondack Park

The area of the Adirondack Park, of which the State owns only a part, is 3,313,564 acres. So many persons are apt to think or speak of the Adirondack Park and the Forest Preserve as being the same, it may be well to state that, of the 1,347,280 acres in the Forest Preserve lands of Northern New York, 1,228,357 acres are situated within the Park, and the remainder, 118,923 acres, are outside the boundary or "blue line" as shown on the last edition of the Adirondack map issued by your Commission.

The actual acreage of the Adirondack Park is somewhat greater than the area indicated by the figures given—how much so it is difficult to say. The statement of area, as reported here, is based on the assessed acreage of each lot, which as we have learned by experience is generally less than the real acreage when determined by a careful survey. Most of the lands in the Adirondacks are bought and sold by the assessed acreage, the old conveyances specifying the number of acres and always qualifying the statement with the words "more or less." Whenever we have found it necessary to make a careful survey and chaining of a lot, parcel or township, we have discovered almost invariably that there was a surplus, that the lot "overrun" the acreage called for in the various deeds, and on which the assessment is made.

This condition is largely due to the loose methods of work in use by the old surveyors who made the original allotments. They used a drag

chain, and ran the lines as fast as they could, some of them being paid by the number of acres surveyed instead of by the days worked. Whenever, in their haste or carelessness, they failed to tally a chain there was a corresponding increase of unrecorded area; and, in some instances, as stated in their field notes, the colonial surveyor "threw in a few chains for good measure."

It would be difficult to estimate, even approximately, how far such methods have contributed to the difference between the assessed and actual acreage; but a careful study of the facts, together with many years experience in these land statistics, leads me to believe that the lots will in the aggregate overrun the old surveys at least five per cent.; and, that while the official assessed acreage of the Adirondack Park is placed here at 3,313,564 acres, the actual acreage is not far from 3,475,000 acres.

The Catskill Park, as defined in the State law, contains 576,120 acres, and includes a part of each of the following named counties: Delaware, Greene, Sullivan and Ulster.

Redemption of Land

During the past year the following described lots which appear on the land list have been stricken off, as these parcels, which were acquired through tax sales, have been redeemed through applications granted in the Comptroller's office pursuant to the provisions of the Tax Law:

Essex County.

Totten & Crossfield's Purchase, Township 45, *Lot* 33.

The 1885 and 1895 tax sales and conveyances therefrom to the People of the State of New York of an undivided 38-48 of this lot were canceled June 7, 1904, on proof of the invalidity of said sales presented to the Comptroller pursuant to chapter 327 of the Laws of 1902, and on the opinion of the Attorney-General as to the sufficiency of such proof. The application was made by George R. Finch, which was based on the claim that this land, while owned by the Adirondack Railroad Company, was exempt by law from taxation. (407 acres.)

The 1881 and 1885 tax sales of the S. W. $\frac{1}{4}$ of lot 253, township 11; the S. E. $\frac{1}{4}$ of lot 5, N. E. $\frac{1}{4}$ of lot 21, and N. $\frac{1}{2}$ of lot 31, Thorn's Survey,

of township 12; and the 1881, 1885, and 1895 tax sales of the N. ½, excepting the S. E. ¼ of N. W. ¼ of lot 32, Richard's Survey, township 12, Old Military Tract, Essex county, were marked "void" on the tax sale books of the Comptroller's office July 24, 1905. This action was taken pursuant to the decisions of the courts and the opinion of the Attorney-General. The applicant in this case was M. V. B. Turner, Plattsburg, N. Y. (790 acres.)

SARATOGA COUNTY.

Glen (John) and 44 others' patent.

Lot 28, all in Edinburg	138 acres
Lot 81	250 acres
Lot 108	250 acres

Which were conveyed from the 1895 tax sale to the People of the State of New York were redeemed therefrom September 15, 1905, by C. M. Sumner, mortgagee. This application was made on the ground that there was a mortgage covering these lots given by John W. Olmstead to Charles M. Sumner to secure the sum of $200, which mortgage is dated December 10, 1895, and was recorded in the office of the Clerk of Saratoga county on December 12, 1895, in book 163 of mortgages at page 289.

Pursuant to section 139 of the Tax Law, as amended by chapter 373, Laws of 1897, a notice of this mortgage was filed in the Comptroller's office April 22, 1899. Through a clerical mistake in the Comptroller's office, ten years ago, no notice of the tax sale of said lots was served on the mortgagee, and hence he claimed the right of redemption. (638 acres.)

SARATOGA COUNTY.

Kayaderosseras Patent, 24th Allotment, Great Lot 4, Lot 2, Sub. 1.

The 1890 tax sale and conveyance therefrom to the People of the State of New York was cancelled October 2, 1905. This cancellation was made on the ground that the land was doubly assessed for each of the years 1847, 1848 and 1849, for which years taxes it was sold at said tax sale, once as resident, and again as nonresident land, and that the taxes levied on the resident assessment were duly paid. (100 acres.)

The different parcels thus redeemed contained, in the aggregate, 1,935 acres. As all these lands have been borne on the printed land list, and

were also colored red on our Adirondack map, indicating that they were State lands, it seems proper to call attention here to the reasons for which this property was stricken from the list The parties who regained possession of these tracts are now carrying on lumber operations there, and hence some timely explanation of the facts seems necessary in view of certain articles that have appeared lately in the public press.

Forest Product of New York

A large part of the office work in the Forestry Department each year is devoted to the collection and compilation of statistics showing the amount of timber that is cut during the previous year on private lands in the Adirondack and Catskill forests. A complete list of all sawmills, pulpmills, furniture factories, excelsior mills, and wood acid factories which obtain their stock from these woodlands is kept in this office. Each firm or individual sends annually a statement, taken from their books, showing the amount of timber consumed during the previous year, each return being made out on printed blanks furnished from this office. The thanks of the Department are due to the various mill owners for their uniform courtesy in making out these reports and for their coöperation in obtaining information so necessary to a knowledge of the forest resources of the State.

I submit here the figures for the output of 1904. The returns for 1905 will not be received until after the close of the year, and not in time for this report.

The total amount of timber cut for all purposes in 1904, as compiled from the returns, amounted in the aggregate to 789,215,523 feet, board measure. It is a significant fact that this production exceeds the entire Canadian import—that is, it is greater than the shipments of lumber from all British America into the United States. In view of the prominence given to this import in tariff discussions the figures given here are entitled to thoughtful consideration. Furthermore, the statistics submitted do not include the mills in the State outside the Adirondack and Catskill counties. Arrangements have been made to secure hereafter returns from these mills also.

Photo. A. Knechtel.

VIEW IN PILING GROUND OF SAWMILLS AT TUPPER LAKE, FRANKLIN COUNTY, N. Y.

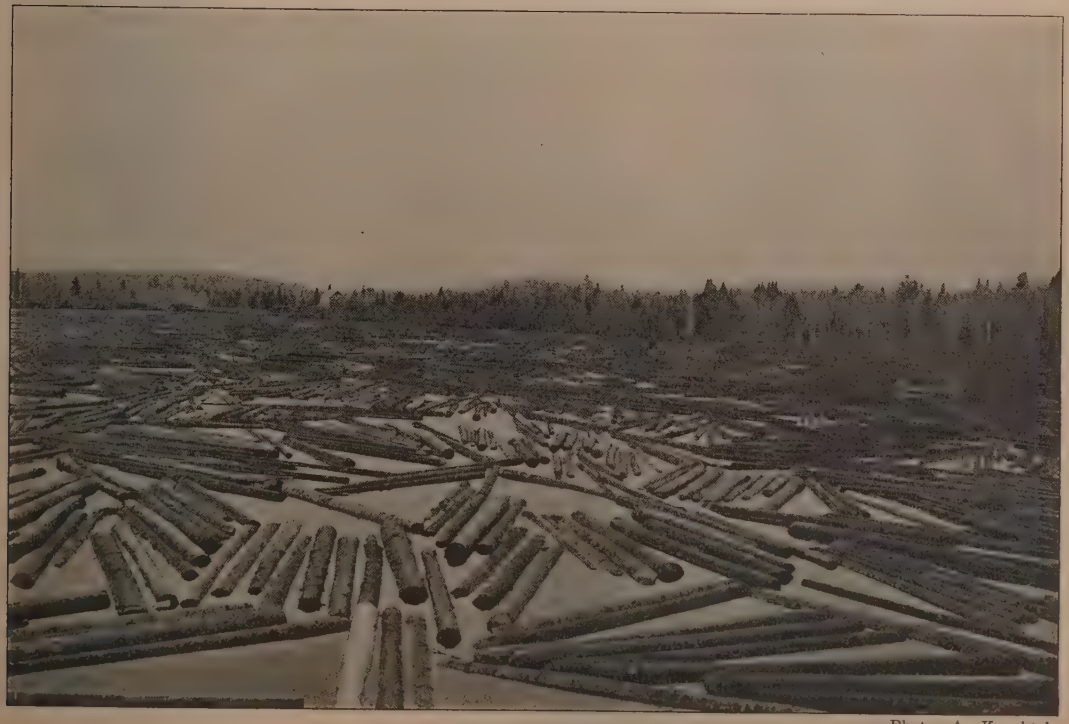


Photo. A. Knechtel.

LOG DRIVE ON THE BOREAS RIVER, ESSEX COUNTY, N. Y.

The timber cut in the Adirondack counties, as shown by the authentic returns from each mill, amounts in the aggregate as follows:

TIMBER PRODUCT OF THE ADIRONDACKS 1904.

	FT. B. M.
Spruce, sawed lumber	174,905,025
Hemlock sawed lumber	63,938,800
Pine, sawed lumber (mostly white pine)	38,031,460
Hardwood, sawed lumber	55,879,479
	332,754,764
Pulpwood—477,415 cords—equivalent B. M.	262,100,835
Cooperage stock, excelsior, etc.—102,287 cords	56,155,563
	651,011,162
Shingles	37,716,250
Lath	53,754,700

TIMBER PRODUCT OF THE CATSKILLS, 1904.

Sawed lumber—mostly hardwoods	72,370,477
Acid factories—103,446 cords	56,791,854
Excelsior stock, etc.—16,470 cords	9,042,030
	138,204,361
Shingles	4,562,750
Lath	5,047,400

SUMMARY.

Adirondack counties	651,011,162
Catskill counties	138,204,361
	789,215,523

The amount of timber reported as cut for pulpwood does not indicate the quantity consumed in the pulp mills, because a very large proportion of the stock used in these mills comes from Canada. Still one pulp mill reported its consumption of Adirondack stock at 50,073 cords; another at 35,394 cords; another at 34,445; another at 33,000; and one at 26,000.

The returns from nine other mills varied respectively from 15,000 to 22,976 cords. Of the 54 other mills none reported over 15,000 cords.

The largest output of any sawmill was reported at 19,561,384 feet; and the cut of six other mills varied from 17,585,000 feet to 10,300,000. There are no sawmills in this State with an output that will compare with that of the large ones in the pineries of the Northwestern States. It is the large number of mills in New York, rather than their capacity, which accounts for the great production.

The reports on which these lumber statistics are based included returns from 595 different mills in the Adirondacks and Catskills, the compilation and classification of which involved a large amount of clerical work that is not apparent from the mere summaries submitted.

Reforesting

The work of reforesting the denuded waste lands in the Forest Preserve, which was commenced in 1901, was continued this last year. Several large plantations of pine and spruce were made on the open plains situated in Franklin county, about four miles north of Paul Smith's, on either side of the highway running from that place to McCollom's. Other plantations were made on the fields along the road from Saranac Lake to Lake Placid.

The ground selected for this work in each case consisted of barren fields on which there was no tree growth whatever, but were covered with a thin sod that yielded a crop of dry, stunted grass. They were abandoned farms which had failed to reforest themselves naturally, and on which not even brier bushes or any scrubby growth had started. In one place, on the Lake Placid road, near Chub Hill, the ground had been burned over by repeated fires. There were no stumps or charred debris on this land; but its condition may have been due to farming operations carried on there a long time ago. There were some areas, also, that were covered with ferns, more or less dense, about twenty inches high.

The soil on each tract was so sandy that agricultural operations had long since been abandoned, and the owners had permitted the land to revert to the State for taxes. Although these lands had proved too sterile for

food crops, they can, under proper management, be utilized for the production of timber and various sizes of wood. Possibly, after many years, these open belts might have commenced to reforest themselves naturally; even in that case the resultant tree growth might not be of a valuable, merchantable kind. But if planted now, there will be in due time a young forest in which each tree will be a desirable one, of some useful species needed by the people, and in number as great as the soil will support.

There are planted forests in Europe,—planted in just such soil—which when cut will yield 15,000 feet of logs per acre, while the wild uncultivated woods of the Adirondacks will not yield one-third that amount, even if the unmerchantable hardwoods are included.

In making plantations last year on this sandy ground, our foresters used in their work certain species which thrive in such soil, and which, as we have learned from experience in our previous work and by observations elsewhere, will attain a rapid, thrifty growth.

In our work this last season we set out 320,000 young plants:

White pine, three-year-old transplants	200,000
White pine, four-year-old transplants	75,000
Scotch pine, four-year-old transplants	90,000
Norway spruce, four-year-old transplants	50,000
European larch, four-year-old transplants	5,000
Total	320,000

As the capacity of our nurseries is insufficient to furnish four-year-old plants each year for the plantations, we imported 200,000 white pines from Germany. This stock arrived in good condition and was planted last May on lot 22, township 18, in the town of Brighton, Franklin county. A careful inspection of this work was made last fall, at which time these plants were in a healthy condition, less than one per cent. having succumbed to the effects of the long transportation and shock of transplanting. The comparatively few dead ones will be replaced next spring with live plants. Small purchases were also made from the nurseries of D. Hill, Dundee, Ill.; from R. Douglass' Sons, Waukegan, Ill.; and from the Evergreen Nursery Co., Sturgeon Bay, Wis.

The Norway spruce, which requires a better soil than the pines, was set out in the open grass lands on lots 77 and 78, township 11, in the town of North Elba, Essex county. These lots are situated on the hill slopes south of Ray Brook and opposite the State hospital at that place. They are in full view from the highway near the sanitarium. The plants set out here were taken from the State nurseries.

For the plantations on both sides of the highway near Chub Hill—three miles west of Lake Placid—the stock was shipped from the State nursery at Saranac Inn Station. It consisted entirely of Scotch pine and white pine, all four-year-old transplants of large size and of a remarkably stocky, healthy growth. Some other lands were planted with stock taken from the nurseries at Axton and Wawbeek. Planting was done in both spring and fall.

Some further experimental work in planting by the "seed-spot" method was done on the cleared land near Forestmere, in the town of Brighton, Franklin county, where 42 acres were planted in this way. The spots, on which the surface was dug over until the bare earth was exposed, were made at intervals of five feet, and from eight to ten seeds were dropped on each, after which they were lightly covered with pulverized earth. This work was done last spring, and in the fall, when a careful examination of the ground was made, it was found that the seeds had sprouted to an encouraging extent. This method is an economical one, as it saves the expense incurred by seed-beds and work of transplanting in the nursery and in the field. Until the capacity of our nurseries is enlarged sufficiently to provide the stock for our plantations, we may have to depend in part on this method in carrying on the work.

Another attempt was made last spring to do something in the way of broadcast sowing, but so far as observed in the fall the results were not entirely satisfactory. Only a partial germination of the seed had occurred. This was largely due to the birds and squirrels which ate the seed thus left exposed on the surface of the ground. As a preventive from depredations of this kind the seeds were treated with a coating of red lead; and, as an experiment some were soaked in a solution of blue vitriol, the latter expedient having been tried successfully by farmers in that vicinity when planting their corn. I do not think that the coating thus applied hindered

the germination of the seed to any extent, for in a test made at the Saranac nursery it was found that this process was not injurious. A seed-bed, set apart for this purpose, was sown with coated seed, and though the sprouts were somewhat inferior in number to those in the adjoining beds, the difference was so slight that the mineral coating had evidently little or nothing to do with it.

The nursery at Saranac Inn railroad station has been highly successful. The fine appearance of the stock, its superior appointments, and the well-kept condition of the beds have elicited words of high commendation from the various foresters from other states who made long journeys expressly to see this nursery. Considerable expense was incurred in establishing a permanent plant, in obtaining muck and other fertilizing material, in building a fence and toolhouse, and in the construction of a complete irrigation system. But these improvements having been made, the cost of maintenance hereafter will be reduced to the minimum.

All the stock in the east half of this nursery was taken up last fall and sent to the plantations which were being made at that time. The ground thus vacated was graded again, after which it received a liberal application of black muck, horse manure, and hardwood ashes. These fertilizers will be plowed under next spring before the beds are made, after which the beds, occupying one-half the nursery, will be filled with two-year-old seedlings, which will remain there undisturbed for two years more. Then they will be sent to the plantations.

The seed-beds made last spring are in a remarkably fine condition, the seeds sown in them having germinated to such a full extent that each bed, four months after the sowing, was completely filled with a dense mass of seedling growth. Mr. Perley Spaulding, of the Missouri Botanical Gardens, St. Louis, Mo., who visited this nursery for the purpose of studying its management and for photographing the beds, described them as containing "an ideal stand of seedlings."

In one bed only was there any loss from "damping off." This occurred during the warm, humid spell, but its progress was promptly arrested by removing the box frames and screens. The slight current of fresh air thus admitted revived the drooping stems immediately and the injury was confined to a circular area of about twenty inches in diameter.

In order to carry on the work of reforesting to any satisfactory extent, additional nurseries will have to be established and maintained. Owing to the weed growth on the planting grounds we are forced to use four-year-old transplants in order to insure success. In Europe, where the planting grounds are carefully prepared and freed from all vegetable growth, seedlings can be safely used, although many of the plantations in Germany are set out with four-year-old stock, once transplanted in the nursery. But the ground at our disposal in the Adirondacks is generally covered with weeds, ferns, or some bushy growth that necessitates a tall, stocky plant. If small seedlings are used, too many of them are smothered and die for lack of sun and air.

I would therefore recommend that a part of the next appropriation for reforesting be expended in establishing an additional nursery and that it be located in one of the Catskill valleys. A part of this nursery should be used for the propagation of broad-leaf or hardwood trees of various species. Throughout the state the newspapers have recently voiced a demand that the commission shall maintain a nursery for raising shade trees that can be utilized on the "good roads" system, and in adorning the public grounds connected with state asylums or institutions of similar character. If it is located in the Catskills a part of the stock could be used for such purposes with good results. As the State maintains expensive hatcheries for the free distribution of young fish, might it not also maintain a nursery for the free distribution of young trees?

The plantation made in 1902, on township 21, Harrietstown, Franklin county, is in a flourishing condition. It is situated on the south side of the highway which runs from Lake Clear Junction to West Harrietstown, and embraces about 700 acres in all, a part of which is a detached area along the Saranac branch railroad near McAuley pond. The actual area that was planted is less than the acreage mentioned, as the tract includes some low, swampy places and, also, some ground on which the rocky outcrop was so bare of soil that it would not support any tree growth.

The young trees on this plantation are all alive, and are, on an average, about waist high. For the first two years they grew slowly, owing to the retarding effect of transplanting and the effort to establish a new root system. But during the last summer they made a rapid growth, the

Scotch pines, which are peculiarly adapted to a sandy soil, having developed leaders from 18 to 24 inches in length. A Scotch pine on the Axton plantation made a leader last summer 31½ inches long. The Harrietstown plantation in three more years will show a young forest of pines higher than a man's head. This tract was thoroughly inspected last spring by one of our foresters, who removed the few dead or defective plants and replaced them with green stock. There is not a blank now in the entire plantation.

The plants on this tract were set out at intervals of five feet. But in the plantations made last spring and fall the little trees were spaced at four feet apart each way. This closer spacing was used to ensure a more rapid height growth, and to force, by the greater crowding, the young trees to shed their lower limbs.

Adirondack Map

Progress has been made in the preparation of the base sheet for a new Adirondack map, an appropriation of $900 having been made for this work at the last session of the Legislature. Through an arrangement made with an engineer connected with the U. S. Geological Survey, all the sheets of the Adirondack region, so far as completed, have been transferred to one large sheet, thereby giving us an accurate geographical base on which to place the landed allotment of that territory.

Another appropriation will be necessary for the employment of a competent draughtsman to overlay this map with the many and intricate lines of the various townships and their interior allotments. I would respectfully recommend that an additional appropriation of $1,200 be asked for at the coming session of the Legislature in order to complete this map, which is so necessary to the proper management of the vast real estate business incumbent on this Department. In view of the large amount of money expended by the State on its Adirondack surveys it would be a serious error if the result of all this labor and expense were not preserved in a suitable map, as this is the only way in which the work can be properly embodied so that it will be available for the use and benefit of the Department and the people at large.

Land Surveying

In order to prevent unintentional trespass on the Forest Preserve by parties who are lumbering on lands adjacent to those of the State it is necessary that the old boundary lines of these lots should be re-established and plainly marked. In too many places the old blazed lines have been obliterated by fire and axe, and wilful trespassers often make the excuse that the State has neglected to properly mark its boundaries. Furthermore, in many places, there are two or more blazed lines, a condition which is apt to induce trespassing or, at least, to raise a dispute as to the correct one.

To handle the business properly a large amount of surveying must be done, and I would therefore recommend that the office of " Land Surveyor " in this Department be created by law; or, failing in this, that an appropriation to pay for the services of a competent, experienced surveyor be inserted annually in the supply or appropriation bill.

I take pleasure in acknowledging here the active and efficient services rendered during the past year by each forester and inspector connected with the Department; also, the valuable assistance given by many of the fish and game protectors and fire-wardens in reporting promptly certain trespasses which occurred in their respective districts. As each one of the officials referred to attended to his duties in so commendable a manner, particular mention would seem like an unfair distinction.

The thanks of the Commission are due the officials of the Delaware and Hudson Railroad Company for their courtesy in furnishing free transportation each day for the gang of tree planters—over 50 in number—from Saranac Lake Village to the plantations at Ray Brook and along the Lake Placid highway during the continuance of the work at these places last fall.

All of which is respectfully submitted.

WILLIAM F. FOX,

Supt. State Forests.

ALBANY, N. Y., *December* 31, 1905.

Report of Superintendent of Forests for the year 1906

HON. J. S. WHIPPLE, *Forest, Fish and Game Commissioner:*

SIR.—The forest law of this State requires, in section 232, that the Superintendent of Forests "shall report annually to the Commission, showing the annual timber product of the Adirondack and Catskill forests and, also, the extent of the forest fires and losses therefrom"; and "shall make such other reports from time to time as may be required by the Commission, or may be necessary for its information."

Pursuant to this requirement I respectfully submit in the following pages a report of the work done by the Forest Department of your Commission during the year 1906. The duties devolving on this Department are varied and numerous, including, among the more important ones, the prevention of forest fires, the suppression of trespasses and timber cutting on the State Preserves, the surveying of woodland tracts to settle questions of disputed boundaries, the litigation of land titles where the ownership of the State is questioned, the prosecution of all trespasses, whether intentionally committed or otherwise, the reforesting of the waste or denuded lands of the public domain, the maintenance of nurseries for the propagation of forest tree seedlings, the preparation of publications giving information on the subject of forestry, the examination and appraisal of forest lands offered for sale to the State, and all other business incidental to the care and custody of the vast landed estate constituting the Forest Preserve of New York.

Reforesting

In my previous reports I have each year described briefly the work done in connection with our efforts to reforest the denuded lands in the Forest Preserve. This work has attracted the favorable notice of many

citizens throughout the State who have written to the Department asking for further information as to the methods employed in our tree planting and nursery work, and some of them have already undertaken work of this kind. As a reply to these numerous requests for instruction I have made here a more detailed report of our foresting operations, and have described at some length the methods employed in our nurseries for the propagation of forest tree seedlings. This report, when printed, will be mailed to persons seeking information as to these matters, and will save the time hitherto used in answering their letters.

The planting of seedling trees for the purpose of reforesting waste lands in the Forest Preserve was commenced by this Department in 1901, when some small areas of mountain land in the Catskills were set out with white and Scotch pine. Since then plantations have been made each year in the Adirondacks, over 500,000 seedling trees having been planted in 1902, and about 450,000 in 1904.

These plantations were made at various places, the largest ones as follows: in Franklin county, on the burned lands situated on the south side of the highway running from Lake Clear Junction to West Harrietstown, and beginning at a point about one mile east of the former; another, on the line of the railroad from Lake Clear Junction to Saranac Lake village, beginning at the three-mile post and occupying the denuded lands on either side of the line for a distance of about one mile in length and a half-mile in width; another, in the same county, on the highway from Paul Smith's to Meacham Lake, occupying the barren plains both sides of the main road north of Mountain Pond and covering the open fields along the branch roads leading on the one side to Osgood River, and, on the other, to Slush Pond; and in Essex county, along both sides of the highway from Saranac village to Lake Placid, at a place known as Chub Hill, about two miles beyond Ray Brook; and another on the abandoned fields situated on the south side of Ray Brook, opposite the new State hospital for consumptives.

The plantation on the West Harrietstown road, made in 1902, is in a very satisfactory condition. Coniferous species only were used on this tract, pine, spruce and larch. The Scotch pine and white pine planted there have now attained an average height of five feet, while many of them are taller than an ordinary man.

Photo. A. Knechtel.

SECOND GROWTH WHITE PINE GROWN FROM WIND SOWN SEED.

Photo. A. Knechtel.

PLANTATION OF 650 ACRES MADE IN 1902; PHOTOGRAPHED IN 1906.

SET OUT ORIGINALLY WITH 4-YEAR-OLD TRANSPLANTS 10 TO 14 INCHES HIGH; TREES NOW 6 FEET HIGH AND MAKING LEADERS EACH YEAR 18 TO 26 INCHES LONG. TREES PLANTED AT 5-FOOT INTERVALS AND ALL ALIVE. THE AREA INCLUDED IN THIS PHOTOGRAPH IS PLANTED WITH SCOTCH PINE.

The plants used were mostly three and four-year old transplants, the balance of the stock consisting of two-year old seedlings, untransplanted. The latter were tried because of our inability to obtain larger plants. The transplants varied in height from eight to fourteen inches. For the first two years these infant trees made but little growth, as their vitality was sufficient only to recover from the shock of transplanting and in establishing the new root growth necessary to further development. But in 1905 and 1906 the pines put on each year " leaders " or tips from fourteen to twenty-three inches long; and if the present rate of growth continues these trees will attain ten years hence a height of twenty feet or more, the crowns will meet, and the young forest will be in evidence. The accompanying photograph, taken this year, shows the condition of this plantation at the present time, all of the trees being alive and in a thrifty condition.

The soil in which this planting was done is so poor that the undertaking seemed at one time a hazardous experiment. The land had been burned over repeatedly, destroying every vestige of humus and leaving only a clear sand that would not adhere when pressed in the hand. The ground was covered with a low, scanty growth of ferns and huckleberry bushes, while here and there young poplars were making their appearance. It was certainly an unpromising site for any future tree growth of merchantable species. But as our Northern pines are found largely on a sandy soil these species were used for a large part of the plantation, and the result has justified their selection. The percentage of plants that died was unusually small, much less than in operations of this kind as observed elsewhere. The blanks were filled the next spring, and now that portion of the plantation occupied by white and Scotch pine shows unbroken rows of young trees without a dead one anywhere in sight.

A few of the white pines on this tract (West Harrietstown) were taken up in 1904 and others set out in their place. These plants were not dead, but their main stems were covered in spots with a white powdery substance showing that they had been attacked by a genus of bark lice, the *chermes pinicorticis*. As a result these plants showed a dwarfed, distorted growth, and although they may have lived they would not attain a desirable height or shape. There was danger, also, that the other trees of this species would

soon become infested, and so the worst of them were taken up and burned, their places being filled again with healthy plants.

A thorough examination was then made of all the white pines, and wherever any sign of this pest was found the young tree was sprayed with a kerosene emulsion of medium strength. This removed all traces of the insect, and the stems soon showed a clean, healthy color. The young trees which were attacked were all in one place near the Harrietstown road. The large area of white pines planted on the ridge a half mile or so to the south was free from this evil. As this insect seems to confine its work to the white pine, the Scotch pines in the same plantation escaped, and show no sign of disease from this or any other cause.

The growth of the Norway spruce in this plantation has not been so encouraging. The plants, though alive, seem to stand still, or, at best, put on short leaders. In places, where the location is favorable, some of them make a promising appearance; but on the whole their behavior is disappointing. It may be that the soil is too poor and sandy; and, I noticed that on many of these plants (Norway spruce) the leaders were cut back by the spring frosts. As the use of this species in subsequent plantations has been attended by similar results we have decided to discontinue its propagation in our nurseries. At the same time, we have on hand in our nurseries 439,080 plants of Norway spruce, three and four years old, of which 100,683 must go to the planting grounds next spring, and hence we cannot discontinue its use until this stock is disposed of. It is hoped that by selecting sites where the soil is better adapted to this species it may develop a more satisfactory growth.

The large plantation near Paul Smith's was made in the spring of 1905. The species and quantities used were: 300,000 white pines, three years old, once transplanted, imported from the nurseries of J. Heins' Sons, Halstenbek, Germany; 25,000 Scotch pines, four years old, once transplanted, purchased from the Evergreen Nursery Co., Sturgeon Bay, Wis.; 20,000 white pines, four years old, once transplanted, from the nurseries of D. Hill, Dundee, Ill.; 5,000 Scotch pines, twenty to thirty inches high, from R. Douglas' Sons, Waukegan, Ill.; and 5,000 Norway spruce, four years old, twice transplanted, from the exhibition nursery maintained by this Department at the St. Louis Exposition; in all, 355,000 plants.

The plants imported from Germany cost six marks, seventy-five pfennig ($1.62) per thousand, f. o. b. on steamer at Hamburg, and were entered at New York free of duty. But the ocean freight, express charges from New York, and cartage over the eight miles from Paul Smith's railroad station made an additional expense of $1.03 per thousand. Hence this German stock cost us $2.65 per thousand delivered on the planting grounds, or a little over one-fourth of a cent per tree. The stock bought in Illinois and Wisconsin cost more, so much so that we have discontinued purchases from American nurseries, and will in the future confine our planting to the output of our own nurseries; or, if that proves insufficient will supplement it with importations from Germany.

The cost of labor in setting out the plants in the field is $325 per hundred thousand, or about one-third of a cent per tree. Two men working eight hours can set out, on an average, about 1,500 plants in a day. So this plantation, or so much of it as is occupied by imported stock cost six-tenths of a cent per tree, including both the purchase or propagation of the seedlings and the labor in setting them out in their final position; and it may be assumed that the expense per tree of subsequent plantations can be figured on this basis. The cost per acre, however, will depend on the spacing, or number of trees per acre, as will be explained further on.

That our foresting operations have thus far cost more than these figures indicate is due to the establishment of new nurseries, the high prices which we are obliged to pay for stock from American firms, the expense of filling blanks in two of our plantations, and the minor mistakes or failures incidental to experimental work under new and untried conditions.

In addition to the 355,000 nursling trees set out on the plantation near Paul Smith's in the spring, there were shipped from the State nurseries 193,000 more to the plantations made in the fall of that year at Chub Hill and at Ray Brook, making, in all, 548,000 trees used in our reforesting operations for 1905, not including plants used for filling blanks at other places.

At Chub Hill we used 65,000 white pines and 50,000 Scotch pines. At Ray Brook we used 61,000 Norway spruce, 5,000 Scotch pine, 5,000 white pine, and 7,000 European larch. The percentage of trees that died in these plantations was much larger than in any of our previous work, and was due,

in my opinion, to fall planting. Our appropriation that year, as usual, did not become available until too late for the spring work, and, rather than carry it over to 1906, we decided to risk the experiment.

The stock used consisted entirely of four-year old transplants from our own nurseries, and in size and thrifty appearance were all that we could desire. But many of these little trees, weakened by the shock of removal from the nursery beds, were unable to withstand the wintry exposure that immediately followed and the severe frosts that occurred in the ensuing spring. Most of the dead plants at Chub Hill were replaced the next spring with live ones, and as the latter had lived and thrived it is evident that the failure of the others was not due to any lack of vitality or to the barren soil. I am aware that in some places where the climate and other conditions are favorable, fall planting of seedling conifers has been successful; but, if attempted on the Adirondack plateau, the long, severe winter, followed by the usual late spring, will cause too large a percentage of failures. With this experience in mind we shall hereafter make our plantations in May.

In addition to the 548,000 trees set out in 1906, some work was done that year near Paul Smith's by the seed-spot method. Forty acres were planted in this way with seeds of white and Scotch pine. In 1906 about eleven acres more of spots were made in which the forester used seeds of Norway, white, native red, and Douglas spruce; also, some balsam and Norway pine.

The spots were made by hacking up the sod or soil with a mattock, exposing a small area of fresh ground twenty inches or more across, which was worked slightly to prepare it for the seed. The loose earth on the surface was then slightly firmed with the foot — an important and necessary part of the work — and eight to twelve seeds scattered over it, after which they were lightly covered with a handful of pulverized earth. The spots were made at spaces of six feet from centre to centre in each direction, though four feet would have been better. Hereafter we shall use the latter interval for plantations of this kind.

The germination was satisfactory, the spots, with few exceptions, showing from one to ten sprouts. In three or four years, when these seedlings have attained a suitable size, the most promising ones will be selected for

Photo. A. Knechtel.

REFORESTING OPERATIONS ON WASTE LAND IN THE ADIRONDACKS.

MATTOCK MEN IN THE FIRST ROW, PLANTERS IN THE SECOND ROW. THE PAILS ARE USED FOR CARRYING THE LITTLE SEEDLING TREES.

Photo. A. Knechtel.

REFORESTING WASTE LAND IN THE ADIRONDACKS.

BROADCAST SOWING OF TREE SEED ON SNOW.

permanent growth, and the superfluous ones pulled up and thrown away. Of the latter, some will be tranplanted in the nearest blanks.

It was noticed in our seed-spot work that the spruces showed the highest percentage of germination, contrasting favorably with the disappointing behavior of these species in our plantations where only the best nursery stock was used. This suggests that, while spruce seedlings of natural growth will live and thrive in the shelter of our Adirondack forests, they may not do so well when exposed to the bleak winds and severe frosts that prevail on the open plains where we make our plantations.

The seed-spot method of reforesting is used to a considerable extent in Europe, especially in Saxony, and in our own work the indications thus far are so favorable that we intend to continue it on a more extensive scale. The cost for labor on a plantation made this way is substantially the same as one in which seedlings or transplants are used; but we avoid the expense incurred in the maintenance of nurseries and propagation of stock. Furthermore, there is such a vast area to be reforested, and the appropriations for this purpose are so disproportionately small that we feel impelled, as a matter of economy, to use this method so far as practicable.

We did some broadcast sowing, also, in 1905, but it was confined to comparatively small areas, and was undertaken as experimental work rather than with an idea of getting satisfactory results. For this purpose seeds of white and Scotch pine were used. Before sowing they were coated with red lead or with a solution of blue vitriol to prevent the birds from eating them. No birds were poisoned through this precaution, as they evidently distinguished these seeds from uncoated ones and did not eat them.

Most of the pine sown broadcast near Paul Smith's did not sprout, although they may come up later on; but an area of a few acres near Ray Brook, which was also sown broadcast, was thickly covered with young seedlings this summer.

The results, thus far, from our broadcast sowing have not been such as to encourage an attempt to do any extensive work of this kind. The germination, for the most part, is too uncertain or uneven. It would, undoubtedly, be highly successful if done on a field of freshly turned, well harrowed earth; but such a preparation of the ground would be more expen-

sive than the use of nursery plants. For these reasons, in gathering our supply of seed this year we limited the work to collecting only such species and amounts as were necessary for the seed beds in the State nurseries and for seed-spot plantations. As the Norway pines bore only a scanty supply of cones in 1906, we had difficulty in securing the few pounds of seed of this species required in our nursery work.

The only plantation of hardwoods undertaken as yet was made in 1904. The land selected for this purpose was a grassy field containing seventy acres, situated at Canoe Point on the lower end of Grindstone Island, St. Lawrence river. It is one of the numerous reservations owned by the State on the south shore of that river and maintained for the free use and recreation of the public. From a ridge of moderate height, the highest in the Thousand Islands, the land slopes evenly to the shore. It was set out with plants of broad-leaved species taken from a temporary nursery which the State was operating in the Catskills at that time. The species planted at Canoe Point consisted of red oak, pin oak, chestnut, black locust, black walnut, white ash, and hickory, 79,580 in all, mostly oak. A few acres of hardwood seedlings were set out at Cedar Point also, another one of the State reservations on the St. Lawrence.

Fully one-third of these plants were destroyed during the next winter by field mice, which, burrowing under the snow, gnawed the bark away or cut off the stem completely. When the damage was discovered measures were taken to poison the mice, and large quantities of corn meal mixed with strychnine were distributed over the field. The plants which escaped injury are now alive and doing well. As the cattle which previously pastured on this ground have been fenced out the grass grows so thick and high that the dead seedlings cannot well be replaced with plants of ordinary size. They would be smothered by the rank, tall grass. As soon as our proposed nursery for the propagation of hardwoods is established we will select large plants and use them for replacing the ones destroyed by the mice.

In 1906 we did comparatively little in the way of new plantations, and confined the work to extending the area of the ones already made. We could not undertake anything further as our annual appropriation for reforesting was cut down one-fourth, and a large part of this fund was needed for the establishment of additional nurseries, without which we

cannot do much planting and do it economically. Hence we bought no stock, and used only the output of our nurseries. A part of these plants were sent to the Chub Hill and Ray Brook plantations to make good the losses incurred by the fall planting done in 1905. Such, in brief, is a résumé of our reforesting operations for the last five years.

The question naturally arises here, How much does it cost per acre to make a forest tree plantation? The answer depends largely on the number of trees per acre which are set out, and that again on the spacing. If the plants are placed at intervals of six feet, in rows six feet apart, there would be 1,210 trees to the acre, assuming that there were no obstacles on the ground to prevent the planting of the entire area. By using stock from the State nurseries the plants will cost when set out in the fields half a cent on the average, including both the propagation and the planting, or $6.05 per acre. But in planting a tract of several hundred acres the number of plants used, and the average cost per acre, would be materially less because of the numerous small areas which cannot be planted owing to swampy or rocky condition or to scattered thickets of second growth. The plantation at West Harrietstown, made in 1902, was spaced at six feet for the greater part of the tract and cost between five and six dollars per acre. Subsequent work done with smaller intervals and a greater number of plants per acre cost proportionately more.

We intend to do our planting hereafter, to some extent at least, at five-feet intervals. We shall adopt this spacing, however, for evergreen or coniferous species only. Where we undertake any reforesting with hardwoods or broad-leaved species we shall space them at intervals of seven feet or more. Pine and spruce have such a tendency to throw out branches all the way down to the ground that the young trees of such species must be crowded enough to force a proper height growth at the start, and, by bringing their crown covers together as soon as possible secure a density and shade that will induce them to shed the lower limbs. Our tree planting is done for the purpose of raising merchantable timber, trees of maximum height with clean trunks free from limbs. Such trees furnish the best logs and most valuable lumber. The shedding of the lower limbs, caused by crowding, enables the tree to take on wood clear of knots; then, having attained as great a height as possible by these means, it can be left to exert

its energy in adding to its diameter. In Europe the foresters plant at intervals of four feet, and as a result a plantation of spruce or fir, twelve to fifteen years old, shows a thicket with interlocking tops that cut off the light from the lower branches.

In our own work we expect that after fifteen years or so thinnings will be made from time to time, and that the revenue from this source will reduce in some extent the first cost of a plantation.

One object in making regular intervals is to have the largest number of trees per acre at a given cost. Irregularity or carelessness in spacing would defeat this object. It has been pointed out in some text books that where trees are set out at the same intervals as the space between the rows — each at the corner of a square area — they would not be equi-distant in a diagonal direction, and would not have the same space in which to grow. For this reason triangular instead of square areas are advocated by some foresters, and in our plantation near Paul Smith's one field was laid out that way

Nurseries

The forest department of the Commission maintains at present four nurseries for the propagation of forest tree seedlings for use in reforesting the waste lands belonging to the State. Each nursery has an enclosed area of two acres. Two of them are situated near Saranac Inn railroad station; one at Wawbeek, on Upper Saranac lake; and one at Axton, all in Franklin county.

With the exception of a nursery in the Catskills which was operated by the Commission for temporary purposes and then discontinued, the first one permanently established by this Department is located at Saranac Inn railroad station. The work in this one has been attended with highly satisfactory results, and its present condition is all that any forester could desire. During the past season the beds and paths presented a neat, orderly appearance, without a weed in sight, the seed beds show a maximum density of growth, and the transplant beds are filled throughout their entire extent with healthy, thrifty stock of good height.

This nursery has a complete system of water pipes and hydrants for sprinkling the plants in times of drought, the supply coming from a large

tank located on a hill near by. The tank, which is well housed, is kept full by a hydraulic ram placed in the outlet of Little Clear Pond near the nursery. A neat, paling fence, painted green, surrounds the enclosure, and the tank house, tool house and forester's office are painted the same color.

This site was selected because there was a railroad station close by affording shipping facilities, and on account of the areas of waste land to be reforested which are situated within a day's haul or less. There was no tree growth of any kind on the ground and so no expense was incurred for clearing the land; but it was covered with a thin, tough sod on which there was considerable quack grass that had to be dug out thoroughly before plowing.

The earth was entirely free from stones, or even small pebbles, a desirable condition; but the soil was very sandy, and, though favorable on that account for the growth of pines, it lacked the fertility necessary for general nursery purposes. To remedy this we used a large amount of fertilizing material. Several carloads of horse manure, purchased at lumber camps, were shipped in by rail, and scattered over the ploughed ground before the first snowfall. Some of the manure was reserved and used in making compost piles for future use.

Our principal reliance, however, was placed on a liberal use of black muck in making the beds, which is valuable for retention of moisture, although of doubtful value as a source of plant food. A rich deposit of this material was found at a place four miles away, and after letting a contract for its excavation it was piled in a large heap by the side of the adjoining highway to dry. When freshly dug this muck was so wet and heavy that hauling it on wagons would have been too expensive, and so it was moved on sleighs the next winter. A chemical analysis of this forest muck calculated on a basis of dry matter showed:

*Organic matter	67.41%
Nitrogen	1.21%

The important constituents in muck are the organic matter and the per cent. of nitrogen. In this case the organic matter has a high percentage, while the proportion of nitrogen is about normal. There is always a little

* Analysis by Prof. George W. Cavanaugh, College of Agriculture, Ithaca, N. Y.

phosphoric acid, and still less potash, but so small in amount as to be insignificant in passing on the value of a muck. Where practical it is well to use a little lime with the muck as was done when the ground was first prepared. To neutralize any sourness or acidity in the muck a liberal quantity of hardwood ashes, unleached, forty bushels per acre, was worked into the beds. The ashes served as a fertilizer, also, for this material contains all the elements essential to plant growth except nitrogen, the lack of the latter being supplied by adding a proper quantity of nitrate of soda. By these means a barren, sandy soil was rendered highly fertile, and the dry, dusty surface converted into ground of desirable consistency.

This nursery is operated for the propagation of coniferous species only, pines, spruces, and larch. Of the various kinds of pine, we are raising white, red (Norway), and Scotch; of the spruces, Norway and our native red spruce; of larch (tamarack), preference is given to the European species. We have some beds of Douglas spruce and bull pine (*P. ponderosa*), but as these species are used sparingly in our reforesting operations they will be given a place hereafter in another nursery recently established for experimental work. The Norway spruce did surprisingly well in the nursery beds, but so poorly in the plantations that we intend, as already mentioned, to discontinue its use and confine our planting, for a while at least, to the three pines. This cannot be done, however, until we have used up the large stock of spruce which we still have on hand.

The arrangement of the beds and paths is the same as in the best European nurseries. The transplant beds are four feet wide, fifty feet long, and raised four inches above the paths. A wagon road divides the enclosure equally in one direction and a broad foot path in the opposite one. The foot paths between the beds are narrow, but wide enough to permit the use of a wheelbarrow.

The seed beds are few in number and occupy only a small part of the enclosure, for one bed of this kind will furnish the seedlings for a large area of transplant beds. The seed beds are twelve feet long and four feet wide, and are made of carefully prepared earth. They are protected on the sides and ends by a framework of boards eight inches wide, placed on edge. These boards are pressed into the ground until they project about six inches above the level of the bed. Large openings made in the boards on the sides

Photo. A. Knechtel.

BEDS OF NORWAY SPRUCE, 4-YEAR-OLD TRANSPLANTS, IN A STATE NURSERY.

VIEW TAKEN JUST BEFORE THE REMOVAL OF THIS STOCK TO A FIELD PLANTATION.

Photo. A. Knechtel.

SEED BEDS IN A STATE NURSERY.

SHOWING LATH SCREENS FOR SHADE, AND WIRE SCREENS FOR PROTECTION FROM BIRDS.

and ends, covered with wire netting, allow a free circulation of air and lessen materially any tendency in the plants to damping off.

Before planting a seed bed the ground is thoroughly moistened, after which the surface is slightly firmed, and then the seeds are sown broadcast as evenly as possible. For the latter purpose, three-fourths of a pound of white pine seed is used on a bed four by twelve feet; and half a pound of Scotch pine, red pine, or Norway spruce. The seeds having been sown they are lightly covered, not over one-eighth of an inch, with fine earth sifted through a hand screen. Any thicker covering will retard germination and increase the liability of failure. If the work is properly done the sprouts will appear in fourteen days or thereabouts, the larger seeds of the white pine germinating somewhat later.

When a bed is sown it is covered immediately with a wire screen of small mesh to keep out the birds and squirrels which, otherwise, would eat the seeds. Then a lath screen for shade, with open spaces just the width of a lath, is laid on, with its frame resting on the edges of the boards that enclose the bed. As both the wire screen and the lath shade are made as light as possible, they can be lifted and removed quickly whenever it is necessary to examine the germination closely.

As soon as the seeds are sown the open spaces in the lath screen are closed with loose lath, and the openings in the sides and ends of the board frames are covered with heavy brown paper to exclude the light. In this way the bed is kept dark until the sprouts appear, a humid condition is maintained, and any sudden change in temperature is avoided. In my opinion the remarkably high percentage of germination in our seed beds is due largely to this precaution.

When the surface of the bed is fairly well covered with the tiny sprouts the loose lath in the shade frames and the paper on the sides of the boxing are removed, admitting light and air.

Our seed beds are laid out east and west, so that there will be a moving light and shade below the lath screens, making an even exposure along the entire surface. At the end of the season the seedlings cover the bed with an even, green mat that hides the ground completely and prevents the growth of weeds. In such of our seed beds as are sown broadcast we save the expense of weeding, but in those where, for experiment, we sow the

seed in drills six inches apart we have to do considerable weeding; and the latter work forms one of the principal items of expense in the maintenance of a nursery

At the end of the first year the lath and wire screens are removed, and the boxing taken up. During the second season the seedlings, now known as two-year olds, attain an average height of four inches and show a dense mass of young foliage that has to be separated by the hands in order to get a glimpse of the ground in which they are growing.

The two-year old seedlings are now ready for removal to the transplant beds, where they are reset and remain two years more. Some careful work is necessary in taking up the plants in a seed bed, especially if it was made by broadcast sowing. The tender roots are intertwined and tangled to a much greater extent than if the seed were sown in drills. For this reason many foresters prefer to plant their seed beds so that the seedlings will be in rows six inches apart, despite the extra expense incurred thereby for weeding and the loss of moisture by greater evaporation from the exposed surface. But with an exercise of proper care the seedlings can be removed from a broadcast bed without injury. Beginning at one end of the bed the workman pushes a sharp spade into the ground below the roots and then with an upward, prying movement breaks up the earth until the seedlings can be loosened by hand. The dirt is shaken off, after which the roots are easily and quickly disentangled without injury. If some of the long roots are cut off by the spade no harm is done. Many expert nurserymen make a practice of trimming the long slender roots before the seedlings are placed in the transplant beds.

As fast as the seedlings are taken up from the seed beds they are carried immediately to the transplant beds where they are set out four inches apart in rows running across the beds. The rows are placed six inches apart. The rows in the transplant beds could run lengthwise, and this is done in some nurseries; but for convenience in weeding we make our rows crosswise

In setting out the two-year old seedlings in the transplant beds a planting board is used, four feet long and six inches wide. Notches are cut in the edge at intervals of four inches, and the holes in the bed in which the seedlings are planted are made at these notches. By this method we obtain a regularity in the rows both ways, which is conducive to a proper

growth and attractive appearance. When the seedlings have remained two years in the transplant beds they are ready for the plantations. They are then called four-year old transplants and are from fourteen to eighteen inches in height. The expense of removing two-year old seedlings into the transplant beds is a trifle over one dollar per thousand.

The reason for transplanting in a nursery is that the seedlings develop a better root system as a result of this process, and hence make a better growth when sent to the plantations. No time is lost as the little trees grow as fast in the transplant beds as in the field. We could use three-year old transplants in our work; but having incurred the expense of transplanting them in the nursery they may as well remain the additional year. The only additional expense is the weeding.

I am aware that in some European countries the foresters use two or three-year old seedlings raised in seed beds, and which have not been transplanted. But this is feasible only on ground which has been prepared at considerable expense, or on land that offers favorable conditions. In our Adirondack work we have to contend with unfavorable conditions that necessitate the use of large four-year old transplants. The soil is burned to the sand or quite sterile, and so only strong large plants can make a start. Moreover, the ground to be planted is, in most places, overgrown with ferns, huckleberry bushes, weeds and briers, that smother the growth of anything less than a four-year old transplant. We have had some experience in the use of two-year old seedlings for field work and much of it has resulted in failures.

The Department is operating also a nursery at Axton, and one at Wawbeek, both in Franklin county. They are used for the propagation of coniferous species only. These two nurseries were established by the Cornell Forestry School, but were abandoned when the work of that institution was discontinued. Part of the stock had been removed, after which for three years these nurseries were neglected and allowed to grow up to weeds. Still considerable stock remained, especially in the seed beds, and rather than allow it to become a loss we decided to re-establish these nurseries and utilize these plants.

This was done at considerable expense, not only for transplanting the seedlings but in clearing out the wild growth which had taken possession, and in keeping down the rank weed growth which appeared immediately

in the newly-made beds. Another unfavorable feature was the large proportion of Norway spruce left by the college management, the use of which we prefer to discontinue.

We intend, however, to operate the Axton nursery as a temporary arrangement only, and abandon it as soon as the stock now there is large enough to go to the field plantations. But the one at Wawbeek should be maintained as a permanent nursery, and as soon as the Norway spruce now there has been used it should be devoted to the propagation of white, Norway and Scotch pine; also larch, to a small extent.

This nursery is well located, on the highway running from the Wawbeek Hotel, on Upper Saranac lake, to Tupper Lake railroad station. It is situated in a high forest, contains something over two acres, and is surrounded by a good wire fence. The soil is composed of the original forest humus underlaid by a rich, black earth, and owing to the shelter of the adjoining forest and moist conditions will not require any irrigation plant. At present the soil is so heavy and stiff that it is not worked easily, and weeding by hand is somewhat difficult. A liberal application of hardwood ashes or sand may be necessary to reduce the earth in the beds to a desirable condition.

In 1906, at the suggestion of the United States Forest service, at Washington, D. C., an arrangement was made for the establishment and maintenance of a co-operative nursery, one-half the expense to be borne by that Department. A site of two acres was accordingly selected on the small plateau at the top of the hill just east of the Saranac State Hatchery. The woods were cleared, the ground ploughed, and the area was planted with peas, preliminary to making the beds. One acre was then enclosed with a neat substantial wire fence to keep out the deer which had already done some damage to the seed beds. Transplant beds will be made next spring and filled with two-year old seedlings from the Saranac Inn Nursery, where we happen to have a large surplus in the seed beds.

This co-operative nursery will be maintained largely for experimental work in the propagation of various untried species, a class of work which we cannot well undertake in our other nurseries, as their capacity is insufficient to furnish the kinds of stock needed for our reforesting operations. A part of this enclosure will be set apart for raising hardwood or broad-leaved trees, and an attempt will be made to introduce on the Adirondack

plateau certain nut bearers — oak, chestnut, and hickory — which cannot be found there now except on the low altitudes of the surrounding foot hills.

At present the seed beds in the Experiment Nursery contain the following species: Silver, sugar, Jeffrey, white, Austrian, bull, Scotch, Norway, and jack pine; white, red, Norway, and Douglas spruce; incense cedar; California white fir; European larch; and native balsam. The coniferous species occupy 36 seed beds, 4 by 12 feet each. The hardwoods, sown in drills, include the following: Basswood, honey locust, common locust, mocker nut hickory, black walnut, butternut, box elder, chestnut, and horse chestnut. Other species will be added this coming spring.

All seed beds in this enclosure are sown broadcast except one of Norway pine and one of Scotch pine, which were sown in drills four inches apart to test some questions as to the best way of making a seed bed. Experiments were made to ascertain the proper density of seedlings. Five beds of Scotch pine were sown with the following amount in each: One bed with one-fourth of a pound of seed; one with three-eighths of a pound; one with half a pound; one with five-eighths; and one with three-fourths of a pound. When these seedlings are two years old we may get some idea as to the quantity of seed per bed necessary to the best results:

The expense of this nursery thus far is:

Labor in clearing and cleaning land	$39 25
Plowing and hauling off brush	88 00
Labor, 1,012 hours, at 22c	222 64
Wire and posts for fence	28 56
Bed frames, lumber and freight	24 47
Wire screens for seed beds	44 00
Seeds	25 05
Peas, 14 bushels	28 34
Insecticides and fungicides	30 39
	$530 70
Less amount received from U. S. Forest Service	200 00
	$330 70

The transplant beds, which will be an additional expense, will be made in the following spring, and will be stocked with seedlings from the

Saranac Inn Nursery. Some of these beds will be set apart for an experiment in the use of one-year old seedlings as transplants.

The stock of four-year old transplants now on hand in the State nurseries and available for the spring planting in 1907 is:

Saranac Inn Nursery:	
White pine	85,370
Scotch pine	4,716
Norway pine	36,288
Bull pine	5,627
Norway spruce	8,605
Douglas spruce	1,000
European larch	4,000
Wawbeek Nursery:	
Norway spruce	55,800
White ash	300
Arborvitæ	900
Axton Nursery:	
Norway spruce	46,278
Co-operative Experiment Nursery:	
Black locust	3,000
Total	251,884
Stock by species:	
White pine	85,370
Scotch pine	4,716
Norway pine	36,288
Bull pine	5,627
Norway spruce	110,683
Douglas spruce	1,000
European larch	4,000
Arborvitæ	900
White ash	300
Black locust	3,000
Total	251,884

Stock furnished by each nursery:

Saranac Nursery	145,606
Forest Experiment Station	3,000
Wawbeek Nursery	57,000
Axton Nursery	46,278
Total	251,884

This comparatively small output is due to the fact that the Axton and Wawbeek Nurseries were not re-established until last year (1906), and that the United States Co-operative Nursery is still lying fallow with the exception of the seed beds.

In addition to the stock described above as available for the spring planting in 1907, there is a much larger quantity of one, two, and three-year old plants which will be ready for the field plantations later on.

I take this opportunity to recommend the establishment of a nursery for the propagation of hardwood or deciduous species. As we expect to abandon the one at Axton within two years the number of nurseries will not be increased by this proposition. This hardwood nursery should be located in the Catskills, preferably in the valley of the Esopus creek and near some station on the Ulster and Delaware railroad.

The State has now over 100,000 acres in the Catskill Preserve and these areas will be increased largely each year by further purchases. Some of these lands are sparsely covered with forest growth and can be greatly improved by underplanting with merchantable species, while other portions, consisting in part of abandoned farms or cleared land, should be reforested with nursery stock. We started a nursery in the Catskills four years ago, at a place about two miles from Brown's Station. The site which was selected without consulting the superintendent, was an unfavorable one, on a hill farm, and the gravelly, stony condition of the soil made its operation difficult and expensive. It was abandoned with the intention of selecting a better site somewhere on the fertile bottom land of the Esopus valley, but for lack of funds nothing has been attempted yet to carry out this plan.

In asking for appropriations to carry on our nursery work and tree planting we are often confronted with the question, why not let these lands grow up to trees and reforest themselves naturally? In reply we point out that the waste lands in the Adirondacks do not always reforest themselves naturally. The Indian Plains on the south branch of the Moose River are entirely devoid of woody growth, and were so described in the field notes of John Richards when he surveyed that township ninety years ago. The Mineral Plains, a treeless expanse of several hundred acres near Cranberry Lake, were in that same condition in 1772 according to the field notes of Archibald Campbell, one of the colonial surveyors who located the great Totten & Crossfield Purchase. Near the Red Horse Chain, on the trail to Witchhopple Lake, is a large opening in the forest where the ground is covered only with ferns and has always been so as far back as the oldest guide and hunter in that locality can remember. Surveyor O'Hara, in 1791, described an Indian cornfield of 100 acres or more, in Arthurboro Patent, Hamilton county, and this field is still bare of trees, or even shrubs. The burned lands and sandy plains in West Harrietstown, near Lake Clear Junction, remained for many years in a denuded condition until they were reforested by the State.

Let it be conceded, however, for the sake of the argument, that the waste and barren lands in the Preserve will in time reforest themselves naturally. But in such a case the tree growth will be composed largely of worthless material and unmerchantable species. The wild forest that will take possesion of the land is not worth one-tenth the cultivated one that could be established there. The primeval forests of the Adirondacks, at their best, have only yielded about 4,500 feet of soft wood timber on an average, the remainder being unmerchantable. But our planted forests when fully grown will yield, at least, 40,000 feet of pine per acre. A wild forest, with its haphazard, undesirable growth, will increase but little, if any, in value, for there is none in it to start with; but a planted forest, every tree a pine or spruce, will increase in value with every rise in the price of lumber. Our people want wood, need wood, and must have it. It is the mission of the forester to grow wood and thus make provision for this ever increasing demand.

Forest Fires

In the year 1906, the period covered by this report, the loss of standing timber by fire in the Adirondack and Catskill forests was comparatively small. While in some of our Northern States there were widespread destructive fires in their forest districts, the State of New York was exempt in a fortunate degree. This was not due entirely to favorable weather conditions or a wet season. The rainfall was slightly below the normal, and at one time last May there was a period of drought during which it was deemed necessary to order out patrols. Many fires started up at this time along the railroads, but they were extinguished promptly by the fire-wardens before any damage was done.

On the forest lands belonging to the State 292 acres of timber were destroyed and 1,026 acres of waste or brush land were burned over. The latter was covered for the most part with ferns or huckleberry bushes and the sandy soil had been bare of humus for many years.

On private lands, in the Adirondacks, timber on 1,376 acres was destroyed or damaged, and 4,266 acres of brush or meadow land were burned over.

In the Catskills no fires occurred on State land; but timber on 2,535 acres was damaged, and the ground fires ran over 3,005 acres of wild meadows and brush lands. A compilation of the figures obtained from the reports of the various town fire-wardens indicates that the loss in standing timber amounted to $2,715 in the Adirondacks, and $5,620 in the Catskills. I think, however, that the fire-wardens in many instances overestimated both the area burned and the amount of damage, especially in the Catskills. This was evident from the statements of the chief fire-warden who in some of these cases, after reading the fire-warden's report, made a personal examination of the burned territory. Furthermore, only a small percentage of the trees were consumed by the flames. By far the greater part were slightly charred, and, though killed by the heat, were still valuable for fuel, and, to a considerable extent, for lumber or other purposes. But the fire-wardens reported most of the scorched timber as a total loss.

In all there were 98 fires in the Adirondacks, and 44 in the Catskills. With the exception of a few that caused the damage here reported, they

were attacked without delay and extinguished before they reached any standing timber.

In the Adirondacks there were 1,294 acres less of timber burned than in 1905; but 1,750 more of brush, or fern growth. In the Catskills there were 410 acres more of timber burned than in 1905; and 1,100 more of waste land.

The largest fire in the Adirondacks occurred May 19, in the town of Greig, Lewis county; it burned 200 acres of timber and spread over 600 acres of waste land. It was started by some incendiary, in the opinion of the fire-warden, but all efforts to detect the criminal were fruitless.

The most destructive one in the Catskills occurred April 21, in the town of Lumberland, Sullivan county; it damaged 450 acres of timber and 50 acres of brush land. The loss in timber was estimated at $2,000. This fire was started by some children who were playing in the woods.

The number of fires in all—including incipient, slight, harmless or otherwise—in each county were:

Adirondacks.

Clinton county	1
Essex county	16
Franklin county	11
Fulton county	2
Hamilton county	12
Lewis county	7
Oneida county	3
Saratoga county	5
St. Lawrence county	4
Warren county	37
	98

Catskills.

Greene county	3
Delaware county	12
Ulster county	6
Sullivan county	23
	44

The number of fires, large, small, incipient, or otherwise, in each month were:

April	49
May	51
June	3
July	..
August	12
September	13
October	3
November	11
	142

The causes, as reported by the firewardens were:

Railroad locomotives	20
Tobacco smokers	14
Fishermen	14
Hunters	8
Campers	6
Supposed incendiaries	11
Clearing land	9
Children at play	4
Berry pickers	2
Bee hunters	1
Imbecile	1
Burning house	1
Unknown	51
	142

The fires caused by tobacco smokers were not due to cigar stubs or ashes from a pipe so much as to the careless habit of these people in throwing down lighted matches in the dead leaves on the ground. The great decrease in the number caused by farmers who were burning brush — at one time the most prolific source of forest fires — is due to the rigid enforcement of the law prohibiting the burning of fallows during certain months in the spring and fall. Still, there were 25 violations of this law, each of which was prosecuted by the chief fire-warden and a conviction obtained.

The fines imposed in these cases by the local justices varied from $20 to $100, and amounted in all to $493. In four other cases the defendants were acquitted; and one case is awaiting trial.

With the constantly increasing number of people in the Adirondack and Catskill districts there is a corresponding increase in the number of forest fires started. It is well to consider here the direful results that would have ensued from the 142 fires mentioned here had there been no organized force to extinguish or fight them.

In fighting these fires there were 1,021 days' labor expended in the Adirondacks, and 982 in the Catskills. The cost to the State, including all other expenses incurred by the fire-wardens, was $2,949.13. A part of this sum was expended in the prevention of fire,—for the payment of patrols, posting of the "Rules and Regulations" along forest roads and trails, and services of fire-wardens superintending the burning of fallows where permits had been issued. Of the 131 forest towns there were 71 in which no fires occurred, and in which no expenses were incurred for any purpose.

Forest Product of New York

But few people ever think of the Empire State as one of the forest States of the Union. Its far famed pre-eminence rests on its great cities, large population, railroads, canals, navigable rivers, productive farms, and diversified industries. And yet, according to the twelfth census 39 per cent. of its area is in woodlands. It includes not only the mountain forests of the Adirondacks and Catskills, but also large wooded areas in other parts of the State, while, on most of the farms there are productive wood lots. The annual product of these forests and woodlands attains an amount that gives New York a place among the lumber-producing States, contributes materially to its wealth and industrial developement, and constitutes an important factor in the forestry question that is now engaging everywhere the attention of thoughtful men and women.

This percentage of area in forest and woodlands (39 per cent.) as given in the last U. S. census is evidently too large. If added to the area of farm land as stated by the same authority it would exceed greatly the total area of the State. The only way the discrepancy can be reconciled

is by assuming that this 39 per cent of area includes wild or brush land already included in the farms. In our calculations we are unable to find over 27 per cent. of forest and woodlands.

In order to formulate an intelligent forest policy and conserve the interests dependent on our forest resources it is highly necessary that we should know, not only the extent of such resources, but how fast these are being depleted. To this end we have devoted considerable time each year to the compilation of statistics showing the actual amount of timber that is being cut for lumber, wood pulp, cooperage, chemicals, furniture, and maintenance of various other industries that obtain their supply of raw material from our forests and woodlands. We undertook this work in 1891, and since then have made an annual report of the same. The steady increase each year demands serious consideration, for with this constantly growing demand there is a corresponding decrease in the supply. The annual increment of growth in the remaining trees is so small in comparison with the removal of timber that it is a negligible factor in the question. Furthermore, it will be many years before the reforesting operations conducted by the State will assume proportions that will in any great degree offset the annual loss.

It is necessary to state here that the great increase in our forest output, as shown in the following statistics for 1905, is due to the fact that in previous years we compiled returns from the Adirondack and Catskill forests only, and did not obtain the product from the small mills in other parts of the State. We were unaware until recently that these outlying woodlands, much of them in the farming districts, were producing lumber and other wood material to any considerable extent. Having decided, however, to make our statistics as complete as possible, and inclusive of the entire State, we submit here figures showing the entire forest output of New York, based on the written returns furnished from the office of each mill, factory, or industry consuming logs obtained from the forests and woodlands within our borders. To this end, and in order to secure accuracy, each firm or individual was cautioned in our printed instructions to omit all stock obtained from Pennsylvania or Canada.

The statistics given here are for the output of 1905. As explained in our previous reports we cannot give the figures for the current year,

1906, because the returns cannot be obtained in time for our annual report.

Product of the forests and woodlands in the State of New York for the year 1905:

Lumber

Spruce.

	Ft. B. M.	Ft. B. M.
Adirondack counties	203,589,532	
Catskill counties	2,935,393	
Farming counties	4,553,549	
		211,076,474

Hemlock.

Adirondack counties	73,051,932	
Catskill counties	23,504,688	
Farming counties	82,993,198	
		179,549,818

Pine.

Adirondack counties	59,838,239	
Catskill counties	12,530,468	
Farming counties	39,701,244	
		112,069,951

Hardwood.

Adirondack counties	78,817,818	
Catskill counties	41,250,682	
Farming counties	127,515,722	
		247,584,222

Pulpwood.

Adirondack counties — 536,580 cords—equivalent B. M.	294,582,420

Roundwood.

(For Cooperage, Excelsior, Wood Alcohol, etc.)

	FT. B. M.	FT. B. M.
Adirondack counties — 51,040 cords—equivalent B. M.	28,020,960	
Catskill counties—129,351 cords, equivalent B. M.	70,914,879	
Farming counties — 124,356 cords—equivalent B. M.	68,271,444	
		167,207,283
Total		1,212,070,168
Shingles		53,374,000
Lath		67,908,300

Summary.

Product by Localities.

	FT. B. M.
Adirondack counties	737,900,901
Catskill counties	151,134,110
Farming counties	323,035,157
	1,212,070,168

Product by Industries.

	PIECES.
Lumber	750,280,465
Pulpwood	294,582,420
Roundwood	167,207,283
	1,212,070,168

Product by Species.

	PIECES.
Spruce	476,200,652
Balsam	29,458,242
Hemlock	179,549,818
Pine	112,069,951
Hardwoods	414,791,505
	1,212,070,168

The amount reported as consumed for pulpwood includes some balasm, estimated at ten per cent. Of the 84 pulp mills in this State, three of them use poplar almost exclusively. These three mills make a pulp which is used in the manufacture of a high grade of paper needed for books and magazines, and for which spruce is not available. In making calendered paper a large proportion of rags is necessary, and poplar is the only species of wood that can be used as a mixture with good results.

In the classification of the product by localities the term "Farming counties," includes the entire State outside the twelve Adirondack and four Catskill counties.

The term "roundwood" includes not only logs, but also the largest of the round branches which are used in the manufacture of wood alcohol, furniture, excelsior, and for fuel in brick kilns. As the material for these industries is to a large extent cut into four-foot lengths the mills make their returns in cords instead of logs, and it is impossible to separate the smaller wood from the logs.

The amount of shingles reported are made from logs cut, or set apart at saw mills, for this purpose. Shingle makers estimate that one thousand feet of logs will make from 8,000 to 10,000 shingles, the estimate varying according to the quality of the logs, and the length of the shingles — sixteen or eighteen inches. The figures given for the total output may therefore be increased accordingly. A large proportion of the shingles made in the Adirondack counties are cedar, and this fact should be noted in connection with the classification by species.

The term hardwoods used in these statistics includes several of the broad leaved or deciduous species. Thus far we have omitted any sub-classification under this general head because many of the mills had not kept any such record of their hardwood logs. Some of the mill owners intimated that they did not want to be bothered by attempting a further addition to their returns, and as their responses to our requests for information are entirely gratuitous, it did not seem advisable to press the matter. We are able, however, to arrive approximately at the proportion of species embraced under the reports of hardwoods from our knowledge of the standing timber and forest composition in the localities whence these mills obtain their logs. The hardwoods cut by the Adirondack mills are confined to

birch, maple, beech, and basswood, and in this order as to quantity. There is also a small proportion, but very small, of elm, cherry and ash. There is no oak, chestnut or hickory on the Adirondack plateau. But the hardwoods sawed in the mills throughout the rest of the State include a large proportion of the latter species.

The 112,069,951 feet of pine reported is almost exclusively white pine, especially so in the Adirondacks. In other parts of the State there are small quantities of Norway, pitch and yellow pine, but if cut they did not probably exceed five per cent. of the total output of pine. The tamarack (American larch) grows freely in some parts of the Adirondacks, especially on low swampy lands, but as yet it is not used in the sawmills to any noticeable extent. It is cut occasionally by farmers to furnish frame timber for barns or houses, for which purpose this species is well adapted. White cedar, as already mentioned, is used largely for shingles, and a great many trees of this species are cut every year for telegraph and telephone poles. But the timber removed from the forest for the latter purpose does not enter into the returns from the mills, and as the work is done by jobbers and farmers we are unable to arrive definitely at this particular, but important, product.

The figures showing the forest product consumed by the pulpmills do not indicate the extent of that industry in this State, for many of them obtain a part, or all, of this stock of wood from Canada. There are 87 pulpmills in New York. Wisconsin comes next, with 38; then Maine, with 30, and New Hampshire, with 10. In daily capacity New York leads also, with 3,561 tons; Maine comes next, with 2,185 tons; then Wisconsin, 1,404 tons, and New Hampshire, 1,048 tons. The daily capacity of the New York mills is divided into 2,459 tons of ground, and 1,105 of chemical pulp. The mills consumed in 1905, a total of 1,301,986 cords of wood, of which 536,580 cords were cut in this State. The total production of pulp for that year was 977,313 tons. The average stumpage value of spruce pulpwood in the Adirondacks is about $2.60 per cord, the price varying with its accessibility, density of stand, and proximity of a desirable stream or railroad.

Forest Resources of New York

In view of the large amount of timber removed each year from the forests of this State it becomes necessary to make a careful inquiry as to the amount that is left. How long will it be before our resources are exhausted?

Various estimates have been made by professional foresters and experts during the last twenty years showing the amount of standing timber in New York. In each case the amount was underestimated. Some of the estimates are already disproved, because a larger amount has been cut since, and the cutting is still going on with a larger annual output than ever before.

We have recently expended considerable time in efforts to ascertain the acreage of woodland in New York and classify it according to its forest composition. As a result of this work I submit an estimate of the amount of standing timber now remaining in the Adirondack and Catskill forests and in the woodlands throughout the State:

	FT. B. M.
Coniferous species (softwoods or evergreens)	7,660,000,000
Broad leaved species (hardwoods) . .	38,400,000,000
Total	46,060,000,000

No great degree of accuracy is claimed for these figures. It is submitted as an approximate estimate based on such information as the Department has been able to obtain after a careful study of the acreage and forest composition. It is tentative rather than final, and will be revised from time to time as further information is obtained. Its value consists chiefly in the fact that there is an entire lack of any other definite statement or estimate.

Of the 7.66 billion feet of conifers we estimate that 5.075 billion feet consists of spruce, nearly all of which is in the Adirondacks, and the greater part of that on State lands. Of the 38.4 billion feet of hardwoods, we estimate that 32.95 billion feet is composed of maple, birch and beech; and that of the latter, 3.9 billion feet is situated in the woodlands outside the Adirondack and Catskill counties. The other hardwood species in the State con-

VIEW IN STATE FOREST, ADIRONDACK PARK.

MIXED SPECIES.

Photo. A. Knechtel.

UNDER THE HEMLOCKS.

VIEW IN STATE FOREST NEAR SACANDAGA LAKE, HAMILTON COUNTY, N. Y.

Photo. A. Knechtel.

sist of chestnut, oak, basswood and elm. The most of the white ash and hickory, because of their greater value, was removed years ago. Nut bearing trees may still be seen in isolated positions on the farms, but these are not included in the estimates of forest or woodland. Prior to 1875, or thereabouts, there was a large quantity of whitewood or yellow poplar (tulip tree) in the woodlands of south-western New York noticeably in Chautauqua county; but owing to the demand for this highly merchantable species, it has been cut, and now a tulip tree is seldom seen outside of parks or lawns.

Trespasses

The State forestry law relating to trespasses or cutting trees on lands of the forest preserve provides that:

"A person who cuts or causes to be cut or carries away or causes to be carried away any trees, timber, wood or bark from state lands in the forest preserve is guilty of a misdemeanor; he shall also be liable to a penalty of ten dollars for each tree cut, taken away or destroyed by him, or under his direction. The penalty so incurred may be recovered in the action to recover damages for trespass or in a separate action." (Chap. 20, Laws of 1900, Part II, Article XIII, Section 222).

Attention is called to the provision of the above section by which a trespass is constituted a misdemeanor instead of a felony. For this reason petty trespassers have been punished by the imposition of a fine equivalent to three times the value of the timber cut, or in some cases by a penalty of ten dollars a tree, and imprisonment is enforced only when the defendants refuse to pay the fine.

At the same time, offenders of this class can be prosecuted for larceny under a section of the penal code, and hence, in cases where there was a flagrant violation of the law, an intentional trespass of great extent, indictments for grand larceny have been obtained and the defendants are now waiting trial. No trespasses of this kind, however, occurred in 1906, the year for which this report is made.

During the year 1906 the legal department of the Commission has collected and turned into the State Treasury $19,651.25 which was obtained from fines imposed for cutting trees on State land. Of this amount

$18,566.25 was in settlement of offences committed prior to the current year, and $1,085.00 for trespasses during 1906.

The forest inspectors, game protectors, and other employes of the Commission are now required by law to report immediately to this office each trespass when discovered, its location, and number of trees cut; also the kind of trees and diameter of the stump. They are provided with printed blanks on which to make out these reports, and which must be mailed to the superintendent as soon as the offender is discovered and the stumps counted and measured. When the report is received at the Albany office it is entered on a book of record and then handed to the legal department of the Commission for immediate prosecution. In no case will a settlement be made for less than three times the value of the timber; and in aggravated cases or repeated offenses the defendants are indicted for grand larceny.

There are no lumbering operations now on State land as formerly, and the only trespasses committed by lumbermen are where the old blazed line of a state lot has become obliterated, or where there is a disputed boundary. The most of the trespasses in 1906 were by persons who cut trees for firewood.

If the question is asked why these trespasses were not stopped before I would respectfully call your attention to the fact that prior to the passage of chapter 285, Laws of 1905, the business connected with the suppression of trespasses was entrusted by law to officials belonging to another department of this Commission. When the business was placed in my hands by this law of 1905 all lumbering on State lands was stopped immediately, and timber cutting on the Preserve was suppressed so far that no violations occurred last year, except petty cases among the poorer class of residents who took trees for firewood, or persons who cut timber along some disputed line or on some lot to which they claimed title and on which they had paid taxes for many years.

Area of Forest Preserve

The Forest Preserve as defined by law includes the lands now owned or which may be hereafter acquired by the State within the county of Clinton, except the towns of Altona and Dannemora, and the counties of Essex, Franklin, Fulton, Hamilton, Herkimer, Lewis, Oneida, Saratoga,

Saint Lawrence, Warren, and Washington, in the Adirondacks; and the counties of Delaware, Greene, Ulster, and Sullivan, in the Catskills, except

1. Lands within the limits of any village or city, and

2. Lands not wild lands acquired by the State on foreclosure of mortgages made to loan commissioners.

The area of the Forest Preserve at this date is:

	ACRES.
Adirondack Preserve	1,415,775
Catskill Preserve	104,524
	1,520,299

The increase in acreage, over that given in my last report, is due to purchases made during the year.

Of the total acreage in the Preserve, 1,296,852 acres are situated within the Adirondack Park, and 94,468 within the Catskill Park. The lands outside the parks have a total area of 128,979 acres, and each lot or parcel was acquired by the State through a tax sale. These outlying, scattered lands are located as follows:

	ACRES.
Adirondack counties	118,923
Catskill counties	10,056
	128,979

The John Brown Farm House

By a deed of gift dated March 29, 1895, Henry Clews and wife conveyed to the people of New York the tract of Adirondack land situated in North Elba, Essex county, known as the John Brown Farm, and this deed was subsequently accepted by an Act of Legislature.

John Brown lived on this farm prior to his participation in the slavery war in Kansas, and his family were living there at the time of his raid at Harper's Ferry. After his death his body was brought there from Virginia for burial, in accordance with a request made by him shortly before his execution, which occurred at Charlestown, Va., December 2, 1859.

In 1870, an association of twenty persons was formed through the

efforts of the late Kate Field, of Washington, D. C., for the purpose of purchasing and preserving the property, and the farm which had already been offered for sale was bought accordingly. Through its agent, Mr. Clews, the association transferred the property to the State.

The farm contains 243 acres, of which only 40 acres have been cleared; the remainder is covered by the forest. The two-story, unpainted farm house, built by John Brown in 1850, stands near the little enclosure in which his remains are buried.

As the care and custody of this property devolves on the Forest Commission, a custodian was appointed who lives in the farm house. He receives no pay, but he has the use of the house and farm free of rent.

As the house was built 57 years ago it needs repairing, and a failure to do this may incur a charge of neglect. I respectfully recommend that an item of $300 be inserted in the Supply Bill to provide for a proper care of this historic place.

Very respectfully,

WILLIAM F. FOX,

Supt. State Forests.

ALBANY, *December* 31, 1906

Report of the Superintendent of Shellfisheries

Shellfish Culture in New York State

By B. FRANK WOOD.*

WE learn from the dictionaries that a farm is defined to be a tract of land under one control devoted to agriculture, etc., and that agriculture is the cultivation of the soil for food products or other useful or valuable growths. All this is very familiar knowledge as applied to the dry land, but that there may fairly be brought within these definitions the operations of an industry in which lands covered by the salt waters of our bays and harbors are tilled, cultivated, raked, harrowed and planted with seedling bivalves, and harvests of a valuable product garnered, constituting a superb food for the masses, is less familiar and to many may seem quite astonishing.

Unique Farming.

It is within a comparatively few years that this unique style of farming has had its growth and development until now many thousands of acres of land under water have been carefully surveyed and the boundaries marked by buoys and stakes. Such lots or tracts are held by the oyster planters by virtue of grants or leases from the State, or other owner. In some cases the lands are leased by counties and towns. Upward of thirty thousand acres in New York State waters have been granted by the State for shellfish cultivation. The separate tracts have been surveyed by the State Surveyor of oyster lands, and for the purpose of preserving the records of boundaries accurate maps have been made and during a series of years have accumulated until these maps, with the notes of surveys, constitute

* Supt. Shellfisheries, State of New York.

a mass of records of great and permanent value to the State and to the shellfish planters.

Surveying upon the water for the purposes of these grants is very different from ordinary land surveying. The work is done by triangulation, the United States Coast Survey signals being used as bases whenever possible. It has been found necessary, however, to have erected by the State many intermediate signals, or monuments, and the State, consequently, has established lines of signals covering two hundred miles of coast.

State Control.

It is no secret that the natural shellfish lands under the public waters of the State have been scraped and raked into a condition of almost entire depletion, until very few traces can be found of beds which could, under the statutory definition, be said to be of natural growth. This disappearance of natural growth shellfish is not strange or wonderful, for it must be remembered that men, while giving nothing back and doing nothing to destroy the enemies of the shellfish, have raked entire bays and arms of the sea bare of their product, thus destroying the balance of nature by use of the most radical means for the annihilation of the oysters and clams.

Natural forces are no doubt sufficient to conserve and even guarantee natural conditions, but when to the attacks of starfish, borer, periwinkle and other enemies of the shellfish are added the sweeping raids of the allconsuming fisherman, there is certainly little left for the mollusk but extinction.

Natural Growth.

The statute defines natural growth lands, or, to be more exact, defines lands which are *not* natural growth to be, lands which "have for five years failed to produce natural oysters in sufficient quantities to enable persons engaged in the planting and cultivation thereof to earn a livelihood by working on such lands."

There are few localities in the State where natural oysters can now be found in quantities sufficient to enable one engaged in working them to make a living even for the short term during which such beds may be workable. The word livelihood in this connection has not been construed or judicially defined. If it means an annual support or maintenance,

OYSTERS ON CLAY PIPE.

then there are now no natural oyster lands in this State sufficiently productive to answer the requirements.

It must be understood that as soon as natural oysters are found, numbers of fishermen crowd to the locality and the shellfish, before they are as large as a one cent piece, are raked up and sold as seed. A few weeks or even days may suffice to deplete entirely the locality of oysters. That the shellfish product under such destructive manipulation was in imminent danger of being practically wiped out, and that oysters might soon be obtainable only as a luxury for the rich, was years ago appreciated by those who had given the subject attention and in consequence the existing system of State control was inaugurated. Under this system lands under water are granted to oyster planters at a fixed rental. The planters are encouraged to make every effort and adopt every improvement which may be expected to increase the quantity and improve the quality of the product. Millions of dollars are now invested in the industry. The arch enemy of the oyster and the bane of every planter, the star-fish, is successfully combated; other enemies are effectively dealt with, and numerous unfavorable conditions are met and overcome.

Improved Vessels.

Appliances have been improved, and the types of vessels used in the business are constantly bettered. The writer is cognizant of a number of power boats now in course of construction which will be adapted to carry burdens of from one thousand to five thousand bushels of oysters. Such vessels are equipped with power dredges operated by independent engines; with star-fish mops capable of raising hundreds of bushels of these pests in a day, and with live steam apparatus for destroying the stars. Planters may now obtain sufficient lands to give employment to their energies and to warrant substantial investments in up-to-date working plants. They have the benefit of carefully made surveys and accurate maps, making it possible to relocate lines when necessary. Each planter may know his own tract and feel that he is protected in his property rights. Without known and visible lines and boundaries, punishment for the larceny of planted oysters could hardly be depended upon. The maintenance of the State system has resulted in the growth of an immense industry, giving

direct employment to thousands of men and a livelihood to the many more thousands constituting their families and dependents.

The indirect results, comprised in the building of boats, the manufacture of appliances, etc., are also large. Best of all, however, a magnificent and delicious food product, rich in the principal elements of nutrition, is furnished to the people, and at a price which permits it to come to the tables of *all* the people. The importance of a food supply of so wholesome and appetizing a character cannot be overestimated.

Who Are the Objectors?

Who then, it may well be asked, are the objectors to such a benign and practical system?

There is, unfortunately, in some of the towns and villages upon our coast an unprogressive element composed of those who prefer to reap where they have not sown; who rely upon what they term their "natural right" to rake where they may choose in the public waters. They deplete, but do not build up! They think because it may be possible to go out upon the waters for a few hours in the twenty-four (when the tide serves) and dig a half peck of shellfish, that it is sufficient reason why such lands should not be leased by the State to private planters. It might as well be said that it is wrong for the government to grant homestead farms to settlers because a few blackberries might be planted upon the lands by any who cared to look for them.

The following extract from the *Fishing Gazette*, under the caption — *The Oyster Leases Should Be Upheld* — is pertinent:

"The lament of the baymen that the big oyster planters by substituting steam rakes and machinery for hand implements used by the fishermen tend to deprive the latter of their means of livelihood is but a repetition of the old cry ever used to block the wheels of progress. It proved ineffective when used against Richard Arkwright and his power loom and cotton manufacturing machinery. It was invoked in vain when Robert Fulton invented the steamboat and Louis Stevenson the locomotive. It will fail in the present instance because personal interests must always give way to public good. Were the policy of the baymen to prevail New York would eventually become dependent for its oyster supply upon the State of Connecticut, where the more enlightened policy regarding the granting of lands under water prevails. The public wants oysters, and to produce

them abundantly resources must be had to modern machinery and up-to-date methods of cultivation. This can only be secured through the enlistment of capital which demands a clear title to the grounds cultivated."

Also this from *The Record:* "In all lines of business there is ever the unprogressive element, and the oyster industry is no exception. Jealous of their more successful neighbors, these few prefer to hinder rather than adopt modern methods.

"The capitalized companies operating steam dredges and cultivating large areas are the ones upon whom we must really depend for our supply in the future. Meanwhile, the petty complaints of the unprogressive will have no effect on the industry at large."

The constantly growing demands of the market require the largest possible production, and were the industry not protected in its property rights against all intruders, improved and up-to-date machinery and appliances could not be used and the business would slip backward until it would amount to no industry at all. Even were a crop already planted, cultivated and ready to garner dependent upon those objectors to be gathered and marketed, they must fail. A gentleman who has given the subject considerable study and attention recently said, "You might as well attempt to harvest the whole wheat crop of the Northwest with a sickle as to depend upon the natural growthers with their primitive implements to take up the oyster crop."

Were these objectors in earnest in their expressed desire to earn their livelihood by work, the system employed by the State would be found to be of the greatest benefit to them, for they, too, may lease the lands. There is and can be no monopoly in this matter as the lands are leased, in each case to the highest bidder after due advertisement, and are usually taken by the applicant at twenty-five cents per acre per annum which is the minimum price as fixed by statute. That such opportunities, at a price that is merely nominal, are not utilized by the objectors would seem to indicate that the labor of making a crop is not coveted by them. It cannot be urged that capital is indispensable in starting this business, as most of the successful planters have progressed from the very smallest beginnings.

In view of the increasing demand for shellfish, there has been a tendency to adopt measures for limiting the supply. For instance, there has been legislation by means of which close seasons have been established, or the size of the shellfish that may be taken limited, etc., the idea apparently being to conserve the supply. But would it not be better to increase

the supply by encouraging the planters to cultivate the many thousands of acres in the State available for this purpose? The objection to granting leases in certain localities has been made that at one time (however remote) natural beds of oysters existed, and that, perhaps, if the grounds were allowed to remain idle they might be revivified and the natural growthers again have an opportunity to gather the product.

If this reasoning were good, it is still true that the exhaustive methods of working which in times past denuded the lands would, if used again, produce a similar result. An increase in the supply is not only possible but inevitable under a wise system, and our sounds, bays and harbors may be made to produce an immense food crop, and the industry should take a place of importance among the wealth producers of our State.

The ease with which land, for the purpose of shellfish cultivation, may be had from the State is made apparent in the following extract from a former report of the superintendent:

"There are two classes of oyster planters: The first is represented by the poor bayman who, without capital, cultivates a small piece of ground by his individual labor, with possibly the assistance of some member of his family or of a similarly situated 'partner.' There are many hundreds of these who, by arduous toil, while subjected to constant hardship and exposure, manage to wrest from the sand and mud of our bays and harbors a frugal livelihood for themselves and families. The numbers of this type are constantly increasing. Second, the planter with capital sufficient to enable him to use every device and appliance necessary or convenient to large operations, including the employment of well-manned steamers equipped with steam dredges, starfish mops, etc., together with extensive oyster houses where oysters are opened or otherwise prepared for shipment and from whence the product is sent throughout the country and indeed to all parts of the civilized world.

"In beginning, or upon enlarging his business, the first care of the planter is to select a tract of land under water which he believes to be unappropriated and suitable for cultivation, marking out the boundaries by stakes and buoys. He then consults the maps and records in the shellfish department of the Forest, Fish and Game Commission for the purpose of determining that the lands in question are open to entry. He is now

prepared to make his formal written application for a lease from the State, for which blank forms are provided by the Department, giving, without actual survey, the best possible description of the ground, making oath that the same has not within five years produced naturally sufficient oysters to enable a man by taking them up to make a living, and that he intends, in case a lease is granted, to use the lands for the purpose of shellfish culture only. The application is thereupon filed and advertised during three weeks by posting a notice in each of three places, to wit, in the shellfish office, in the post office nearest the location and in the office of the town clerk of the town in which the tract is situated, the time and place of sale of the grant being indicated in the notices. At the expiration of the period of advertisement a certificate is prepared, signed and filed by the clerk of the shellfish office that no objection, or that objection, as the case may be, has been made to the granting of a lease. If no valid objection has been received within competent time, the superintendent of shellfisheries and the surveyor of oyster lands unite in a certificate (they having made any necessary investigation of the ground) that the tract is not, or does not include, a bed of oysters of natural growth. At the shellfish office, upon the appointed time, the grant of the lease of the land for the purpose of shellfish cultivation is offered at public auction and is awarded to the highest bidder, the minimum price being twenty-five cents per acre per annum. After the lease has thus been granted, the land is carefully surveyed and the boundaries marked by the State Surveyor of Oyster Lands, who plots the tract upon the maps of the office and furnishes an accurate description for the purposes of the deed of lease which is then prepared, executed by the Commission and delivered to the lessee. Only inhabitants of the State may become original lessees or hold by assignment of lease."

Propagation of Oysters.

The propagation and cultivation of oysters are practically two very different processes, and the distinction between them should be constantly kept in mind while considering the methods of the oyster farmer. Oyster propagation is a simple and interesting operation in the laboratory, but it has not yet been carried on upon a scale sufficiently extensive to be of importance to the planter.

The minute eggs of the female oyster may be fertilized by the sperm of the male in a test tube, or in an ordinary tumbler containing sea water at the proper temperature. Numerous conditions, some understood and some unknown, must be in proper adjustment in order to insure a continuance of life to the embryo bivalve. There are questions of temperature, specific gravity of water, salinity, the circulation or currents in the water, food supply, etc., making much further research and experimentation necessary before artificial propagation can be made of value to the practical oyster planter. Meanwhile those engaged in the industry are watching these experiments with the greatest interest and hopefulness. It will thus be understood that, as the trade can at the present time make no avail of the methods of *propagation*, the planters employ their energies in the use of every intelligent method of *cultivation*.

Cultivation of the Oyster.

The planter begins his work of cultivation when the young oyster has completed the first, or free swimming stage, of its existence, and attaches itself to the oyster bed; or, rather his work antedates this period, for he must prepare the bed and have it swept and garnished and made suitable and clean or the minute oyster will have none of it, preferring to make further search as it is carried along by the tides and eddies until it shall find a proper home or perish an unattached atom, a minute victim of one of the myriad unnoticed tragedies of the deep.

In this connection the writer said in his last report: "The oyster exudes thousands of eggs which (after fertilization) are carried along by the tides until a clean, hard surface is encountered, when, if the limit of existence in the free swimming stage has not been reached, it attaches and there remains during its life history unless removed by the planter to other grounds. The uncertainties of the business to the planter are apparent. The spawn from the oysters upon his own grounds may be carried miles away by the currents, while the set upon his lands comes from an unknown quarter; or, he may fail entirely to get a set, with the result that the money spent by him in preparing the beds has actually been thrown overboard. Thus from an oyster farm, other lands may be fertilized and enriched."

YOUNG OYSTERS ON CONCH SHELL.

Preparation of Beds.

The planter at the proper season carefully cleans the beds by scraping over them with dredges, and tests the bottom so that he may have full information of its character and formation. Oysters cannot live in mud or slime, they require a clean, gritty surface. He then, selecting those portions of his lands which he has found to be suitable, spreads over the bottom a covering of shells which have been cleaned and dried or strews it with clean broken stone. This is done in the early summer, just prior to the spawning season. Sometimes the experiment of placing upon the beds large oysters, called "spawners," which are ready to exude their spawn and milt is tried, but the oyster set may be said to be like the wind,—none can tell whence it cometh.

The preparation of the larger beds may cost many thousands of dollars which have actually been cast upon the waters in the hope of a suitable return.

Jingle shells and quarter-decks are favorites for planting, as they are fragile and easily detached from the oyster when it reaches marketable size. The quantity of shells planted in this State reaches well into the millions of bushels.

The spawning months are known to the public as being those months of the year, the names of which are spelled without an "R."

The Oyster Set.

As may be imagined, the planters anxiously watch during the advancing season for the first indications of a set of young oysters, and when it is definitely determined that there is indeed a good set, their joy may be said to be full, for an abundant set of young oysters means a replenishment of stock which may be made to extend over several years of dearth of set. A satisfactory set of oysters is not by any means a circumstance of annual occurrence. Indeed, from the summer of 1899 to that of 1904, a period of five years, there was no general set. Here and there, in little spots, set was found, but not enough to ease the situation materially; but, at the present writing, it may be said that the bountiful set of 1904, followed by another satisfactory set during the current year (1905) has delivered the planters from their chief difficulty, filled their hearts with rejoicing and, it may be

presumed, has substantially added to their bank balances. The public has been not less blessed in the retention, at a reasonable cost, of this inimitable food supply and, to sum up the situation, "an oyster famine has been averted."

As this article makes no pretention to being a scientific treatise, the writer is of the opinion that the following bright little sketch concerning the perils of a young oyster which appeared in the columns of the *Philadelphia Public Ledger*, may not be deemed inappropriate.

Perils of a Young Oyster.

"Popular fallacy sets down the oyster as the emblem of crass witlessness and lumpish unprogression. Now, by rights, the wild oyster—for all his outward plainness—is the most picturesque of all the monsters of the deep. Not from the chafing-dish standpoint alone is he a thing of interest. His career reads like a striking romance. Of all the wild oysters the most picturesque is the American. Challenge, if you will, the imputation of nationality to shellfish; the American oyster is none the less the personification of Yankee-Doodleism. His declaration of independence is made as soon as—I had almost said before—he is born. The effete European oysterling lies coddled within the mantle of its mother until it is of visible size and can sport a rudimentary shell of its own. But the American, mark you, deserts its happy home for open ocean while it is yet not so much as a finished egg, a mere unfertilized possibility of an oyster.

"Fate willing, it meets in the sea the vitalizing principle and develops with startling rapidity into a dancing slimedrop, with distinct views of its own. But fate oftenest turns down her inexorable thumb, and the rash eggling ceases to be a possibility at all. Were it not for this wasteful provision of nature, in a few seasons the wet sea would become as the dry land. For as the ordinarily provident oyster parent presents the world yearly with some 16,000,000 of eggs, the best of them achieving a record of 60,000,000, it takes but little figuring to show that if all the offspring survived the fourth generation of oysters would brim the ocean beds full.

"To avert this calamity nature makes life lively and strenuous for the young oyster. Most friendless of all the youngsters of the earth, he is an infant Ishmael from the very egg. Sudden chills strike through the unkindly sea and threaten his tender life. A cold rain sends thousands of luckless oyster babes to an untimely grave. Great mouths gape wide to devour him; any big, idle fish, sailing careless, open-mawed, may gulp down millions of his kind and thereafter go home with a keen appetite for breakfast.

His own mother, who is after all a little more than a superior sort of sieve for sea water and its microscopic life, will incontinently swallow him if he comes her way. A hapless atom, he.

"The oyster nursling whisks his way bravely through the sea of troubles. He is now a little two-walled vase of slime, with an exciting stomach and little hair oars to drive him through the water. The wonder is that the undirected young thing knows what to make of himself at all. Scientists are hard put to it to discover wherein he differs from any one of a half dozen other minute sea babies. Nor can their strongest microscopes search out any reason why he should not inadvertently grow up a starfish. But he makes no mistake. He gets his organs proper to a well-bred oyster and builds him a little protecting shell as fast as ever he can.

"Spared to days of discretion, he prepares to settle down in life. And here a fresh danger besets him. The choice of a bed is a life and death affair. For even now he is but one five-hundredth of an inch in diameter, and rather thinner than a sheet of paper. The merest film of slime upon the shell he fastens to is enough to asphyxiate him, and snuff out his little vital spark. And clean shell surfaces are by no means common in the brackish waters of bays and river mouths. Oyster infants are smothered in their beds each year in myriads.

"This final peril of his free-swimming youth evaded, a clean foundation secured, the little oyster cultivates a placid disposition and hardens his shell. But not in unmolested peace. As a delicacy he is much appreciated by the larger sort of fish, who long to crunch his fragile house walls and feast upon his juicy little body. His only protection lies in formidable armor. He builds upon the native oyster bed, where lime from dissolving shells is to be had for the taking, and adds layer to layer for dear life.

"But even inside crusted walls of lime he is not safe. The starfish, that flabby innocent called 'devil's fingers,' has a pull which avails much on the oyster beds. It wraps its wicked, suckered rays about the luckless bivalves and patiently pulls until the oyster inside, fairly tired out in the struggle to hold his house together, capitulates and is sucked into the starfish's greedy stomach. Another enemy, the oyster drill, whose tongue is a rasping file, perforates his thickest shell and eats him out of house and home Sea worms, with the best intentions in the world, twine their stony folds about his valves and incarcerate him to die of slow starvation. Barnacles crowd him to death, and in his old age young oysters plant themselves thick upon his shell and smother him beneath them. Altogether, statisticians say, he has but one chance in 1,145,000 of reaching a ripe old age.

"So much for the life of the wild oyster and the losing game he plays.

Where he leaves off, man takes up the tale. The dredge and the tongs of the jolly oysterman constitute the manifest destiny of a right-minded oyster."

Enemies of the Oyster.

With the oyster set the planters always look for a set of starfish and of other enemies of the oyster.

In Long Island Sound, the starfish is the enemy most to be dreaded. The set of stars seems to have some relation to the oyster set, and, in seasons when the young oysters are abundant, the planters look for a like abundance of stars.

This fish is certainly an ill and evil star to the oyster and to its cultivators. At times covering the bottom to a depth of eighteen or twenty inches and extending in solid bunches or masses over considerable areas of ground, they are capable of blanketing entire beds of oysters in their slow but sure advance, leaving not a living bivalve behind. They are very hardy and tenacious of life, and may even be deprived of some of their limbs or rays and regain these members by a new growth which makes good the loss. Unless these pests are constantly attacked in season and out of season, and their numbers reduced, they are sure to overwhelm and totally destroy the oyster beds. This refers particularly to shellfish lands situated in Long Island Sound, for it is true that there are some localities where comparative freedom from this enemy is enjoyed.

Many devices have been invented and used for the purpose of destroying the stars. The one now in general use by the planters is the star-mop or tangle. It is made of cotton cords or strings, arranged in large tassels or bunches, attached to a steel frame and drawn over the beds by means of the dredging chains and machinery. The stars become entangled in the meshes of these mops and are raised in large numbers. Mr. Herman D. Pausch has made many experiments for the purpose of perfecting some better plan of combating this scourge. He has found, he believes, a practicable method for use in localities where there is not too great a depth of water. His plan is to make a continuous wall or ridge of lime along the boundary of the bed to be protected. He has accomplished this by filling paper bags with quick lime and dropping these bags along the line. The paper serves to hold the lime from being carried away by tides while

YOUNG OYSTERS ON GLASS BOTTLE.

descending through the water. The water will of course slack the lime, but Mr. Pausch states that so long as the lime barrier remains intact no starfish will cross it. He has experimented quite extensively in this direction, and is of the opinion that the results attained will warrant the use of his methods upon a large scale. One of his tests consists of placing starfish within lime enclosures, and though kept there for considerable periods of time not one will attempt to cross the line which separates it from freedom.

Mr. Pausch says that the lime barrier constitutes a veritable dead line for the sea star. He considers the use of paper bags a somewhat clumsy plan for getting the lime to the bottom, and is now engaged in perfecting an apparatus by means of which he may feed the lime through a hose or pipe so drawn over the ground as to leave an unbroken ridge of the material on the bottom.

A gentleman connected with the scientific department of one of our great institutions of learning has, at the request of the writer, undertaken to make an exhaustive study of the starfish, its habits, its life history and of the enemies to which it is subject, with a view of finding some practicable method of exterminating, in large numbers, this terror of the oyster planter.

Many different theories have been advanced concerning the manner in which the star attacks the oyster. In the light of recent investigation, however, there seems to be no doubt that he, by a strong and continued pull, forces the valves open. Upon the under sides of the rays or fingers of the star are rows of suckers, and, after embracing or encompassing the oyster with these fingers, he attaches the suckers and applies a steady straining pull in opposing directions, maintaining the strain until the muscle in the shellfish, which serves to hold the shells closed, gives way, the valves open, and the oyster surrenders. Thereupon the star pushes forward his stomach between the shells and absorbs the oyster.

It must not be supposed that the capture of one oyster will satisfy the hunger of a starfish for any length of time. On the contrary, he is relatively one of the most voracious monsters of the sea, and pursues his depredations almost unceasingly. The vast numbers with which the star overwhelms the shellfish beds, taken in connection with his insatiable appetite, make it clear that nothing but eternal vigilance on the part of the planter will hold the day against him.

There is, consequently, a community of interest among the planters in attacking and destroying the star. For, in protecting his own beds, a man also assists his neighbor to whose tracts the stars might go, and, conversely, any neglect of one's own ground constitutes a menace to all the cultivators in the vicinity.

The work of destroying stars is a duty, as before intimated, in which the natural growth oysterman usually takes no part. He takes the oyster where he can find it, appropriating the bounty of Heaven without accepting any responsibility as to the conservation of a further supply.

When the star-mop is drawn to the surface, its load of stars is deposited in a vat or tank and treated with boiling water or live steam. The oyster boats are well equipped with apparatus for this purpose, the steam or water being conveniently taken from the vessel's boiler, though some of the steamers have special boilers for this purpose.

Attempts have been made to turn to some useful purpose the large quantities of stars taken from the oyster beds of Long Island Sound, and it goes without saying that this should be a more or less valuable by-product of the industry. Properly mixed with other material, they constitute a valuable fertilizer. Frequently, farmers residing in the neighborhood of oyster planters have contracted for the catch of stars, but the oystermen say that in practice it does not work well, as they find that they cannot depend upon having the accumulation of dead stars regularly removed from their premises, and of course they cannot allow them to remain and putrefy. As a consequence, the usual mode of disposition is to throw them overboard after they have been killed in the live steam or boiling water bath.

A Set upon a Set.

Important as the mopping for stars has been shown to be, it is still a question of delicacy, requiring the exercise of an experienced judgment, to know when this work must be suspended in order to prevent the calamity of inducing the deposit of a set upon a set. It has already been shown that the young oyster attaches to any clean, hard surface, and it will be understood that the operation of mopping for stars has a tendency to so clean and brighten the shells of the oysters on the beds that there is danger of a new set of spat, from late spawners, being deposited upon the shells of the

earlier set. Such an occurrence may be highly calamitous, as the new growth may smother and kill the first growth or, at best, make it bunchy, clumsy and comparatively unmarketable. The oldest and most experienced planters are frequently subjected to this misfortune.

Seed Oysters.

At the beginning of the warm season, succeeding the season of spawning, thousands upon thousands of bushels of young oysters (called seed) are taken from their native beds and planted in more or less distant bays and harbors, there to grow and mature under a new and different environment. This practice has occasioned a business demand for very young oysters, concerning which the general public is almost wholly ignorant. It constitutes, however, an important branch of the shellfish industry. There are many bays upon our coast where the oyster set is so small as to be almost a negligible quantity, and yet in these waters young oysters (seed), brought from other localities and planted, make rapid development, attaining marketable size in perhaps one third of the time that would be necessary for like growth in their native waters. These conditions occasion a constant shifting of oysters from one locality to another. Frequently they are moved to great distances. Quite a trade in seed has grown up with the Pacific coast states, calling for many carloads of stock from Long Island Sound.

The price of oyster seed varies under the laws of supply and demand. Prior to the recent time of dearth of set (1899–1904), from forty to forty-five cents a bushel was a usual price for seed, but under the conditions of continued scarcity the price mounted until it was often quoted at from eighty cents to one dollar, and in some instances one dollar and a quarter was paid.

Marketing the Stock.

As the season advances and the water gets cold the oysters take on fat, and those of marketable size are dredged for market. The harvesting of a crop is the happy culmination of what may be considered as a somewhat hazardous experiment. It means that the product is at last safe, and it never is safe until actually gathered; that the dangers of shifting sands, of boisterous waves, of intense cold and ice, of starfish, borer, drumfish, periwinkle and other enemies of the bivalve are past; that the planter who

has labored incessantly and intelligently will have his reward and the public a food fit for sovereign Americans.

That portion of the stock which is to be sold in the shell is usually assorted into two sizes called "box" and "culls." The oysters in the shell are shipped in barrels and bags, while the opened or "shucked" oysters are packed in tubs and half barrels.

There are about two hundred and fifty oysters in the shell to the bushel, giving when opened about one gallon of solid meat. The tubs hold nine gallons with six gallons of meat, the half barrels contain eighteen gallons with twelve gallons of solid meat.

Most of the oysters produced in this State find a market in New York city, which is a distributing point for the United States and Europe. Within the past year Fulton market, on the East river side of New York, has ceased to be an oyster market of importance. This is owing to the remodeling of that market and to the lack of room for the oyster barges at the docks. The result is that the business at the West Washington oyster market has been considerably increased. This market is situated at the foot of Bloomfield and Gansevoort streets, two blocks south of West Fourteenth street, and fronts on the Hudson (or North) river. On the river side of the market there is an enclosed basin where boats may be secure while unloading their cargoes of shellfish. The unique and commodious house-boats which are moored to the docks are picturesque objects, quite familiar to residents of the city. These barges are really two-story houses, built upon scows or floats with extensive expanses of floors or decks upon which large quantities of stock may be stored, assorted, opened, packed, shipped, etc. The ends of these houses fronting the street may properly, perhaps, be called the bows, and are constructed with more or less attention to architectural effect, so that the facades are not unattractive. Upon the top, or cornice, of each boat, usually extending across the entire front of the structure, is a sign by which may be known what firm or company is doing business within. From just behind the sign, upon each barge, rises a tall flagstaff, upon which on suitable occasions the flag is displayed. Therefore these singular craft have each at least one set of halliards which may be used for a proper purpose. These boats are fixed with more or less permanency in their berths and have every appearance of busy establishments of trade.

They rise and fall with the tides, which keeps them upon a level corresponding with that of the decks of the boats of the oyster carrying fleet, thus facilitating the loading and unloading of stock. These houses may be moved from place to place when necessary by tow boats.

Statistics of the Industry.

The writer has endeavored to make a careful and thorough use of all the means at his disposal for the purpose of collecting and collating reliable data concerning the extent and value of the oyster crop; the number of men employed in the industry and the number, style and value of vessels used, as well as the value of appliances and of shore property. The oyster planters upon our seaboard were furnished with blanks containing questions by means of which information was sought upon the following points, to wit: Number of acres cultivated; location of tracts; number of gas and steam vessels employed; tonnage of gas and steam vessels; value of gas and steam vessels; value of steam and gas outfit; number of sail vessels employed; tonnage of sail vessels; value of sail vessels; value of sailing outfit; number of other boats employed; value of other boats employed; value of such outfit; number of tongs used; number of dredges used; number of hands employed; amount paid in wages; value of shore property used; quantity of oysters produced for market, in bushels; quantity of seed oysters planted, in bushels; bushels of seed oysters sold; value of seed oysters sold; bushels of clams produced; value of clams sold and the principal market for the products.

In cases where such blanks were not filled and returned as requested, personal visits to the oyster localities were made by a representative of the Shellfisheries office. By use of these methods a mass of detailed information was obtained which has been verified by comparison with reports from the transportation lines, market vessels and market wagons.

The following figures are presented as being as nearly accurate as may be obtained, the totals rather understating the real quantities, as no account has been made of oysters consumed in the localities of the beds where they are grown:

Oysters Brought into Market.

	BUSHELS.	POUNDS.
Transportation lines	2,402,060	204,875,100
Market vessels	2,880,000	244,800,000
Market wagons	800,000	68,000,000
Grand total	6,082,060	517,675,100
At $1.25 per bushel, value		$7,602,575

The Business by Localities.

The following figures from Long Island Sound include returns from Pelham Bay, Manhasset Bay, Oyster Bay, Hempstead Harbor, Huntington Bay, Northport Bay, Port Jefferson Harbor and from other smaller bays along the Sound shore, as well as from the lands located under the waters of Long Island Sound proper. It is estimated that the actual figures presented represent about one-third of the quantity of oysters produced, and that a fair estimate would put the yield at 1,180,000 bushels. Good prices were obtained for this stock, which is known to the trade as " East Rivers."

An increasing business in seed oysters is shown by the reports. The extent of the business carried on with the oystermen upon the Connecticut shore is difficult to estimate, but is without doubt increasing.

Long Island Sound and Adjacent Bays.

Acres held under lease	4,978.8
Acres held under franchise	4,730
Total acres cultivated	5,856.2
Location of tracts—Long Island Sound and vicinity.	
Number of steam and gas vessels employed	28
Tonnage of steam and gas vessels	579.97
Value of steam and gas vessels	$135,100
Value of outfit	26,550
Number of sail vessels employed	19
Tonnage of sail vessels	111.74
Value of sail vessels	$10,400
Value of outfit	2,075
Number of other boats employed	36
Value of other boats	$2,145

YOUNG OYSTERS ON TIN LAMP.

Value of outfit	$1,573
Number of tongs used	69
Number dredges used	138
Number of hands employed	167
Amount paid in wages	$67,550
Value of shore property	25,100
Bushels market oysters produced	335,900
Bushels seed oysters produced	188,930
Bushels seed oysters planted	130,800
Bushels seed oyster sold	42,930
Value seed oysters sold	$17,965
Value market oysters sold	337,550
Bushels clams produced	9,500
Value clams sold	$9,860
Principal market	New York

Jamaica Bay.

The returns from this locality show a considerable falling off from last year. There were several reasons for this result.

1. The planters have been more or less confused in respect to their titles to land.

2. The dearth of set and consequent high prices for seed tended to their discouragement.

3. For several years the crops had been far from satisfactory. As the season advanced, however, those who had refrained from planting realized that the mistake of not putting in a good crop would be most costly to them, as never had oysters from this bay (known to the trade as "Rockaways") been more plump and delicious. Prices have been good and those planters who have been able to supply the market with this stock have had a most profitable season.

The proximity of Jamaica bay to the New York market reduces the cost of shipping to the minimum. About 560,000 bushels were marketed during the year.

Acres held under lease	630
Acres held under franchise	44.6
Total acres cultivated	146.58

Location of tracts — Jamaica bay.

Number gas and steam vessels employed	13
Tonnage of gas and steam vessels	174.25
Value of gas and steam vessels	$35,100
Value of outfit	79,555
Number sail vessels employed	16
Tonnage of sail vessels	151
Value of sail vessels	$14,950
Value of outfit	5,775
Number of other boats employed	116
Value of other boats	$6,254
Value of outfit	4,575
Number of tongs used	223
Number dredges used	45
Number of hands employed	159
Amount paid in wages	$50,824
Value of shore property	17,800
Bushels market oysters produced	338,800
Bushels seed oysters planted	103,650
Bushels seed oysters sold	150
Value seed oysters sold	$90
Value market oysters sold	210,325
Bushels clams produced	10,090
Value clams sold	$30,340 75
Principal market	New York.

Princes and Raritan Bays.

The oystermen of this section have had a most satisfactory year. Stock has been better and more plentiful than during ten years past.

Statistics were obtained from less than one-half the planters. It is possible, however, to get a very fair idea of the production and values of the locality. During the year there were marketed from these two bays, including the kills, over 890,000 bushels of oysters. This stock was brought to the New York market principally by the vessels engaged in the business, many of which carry a load daily to New York.

Acres held under lease	183.6
Acres held under franchise	1,548
Total acres cultivated	1,554

Location of tracts — Raritan and Princes bays.

Number gas and steam vessels employed	12
Tonnage of gas and steam vessels	294
Value of gas and steam vessels	$58,000
Value of outfit	9,850
Number of sail vessels employed	18
Tonnage of sail vessels	205
Value of sail vessels	$15,200
Value of outfit	5,500
Number of other boats employed	44
Value of other boats	$2,530
Value of outfit	245
Number tongs used	121
Number dredges used	66
Number hands employed	151
Amount paid in wages	$39,650
Value of shore property	5,000
Bushels market oysters produced	350,000
Bushels seed oysters produced	3,000
Bushels seed oysters planted	27,550
Bushels seed oysters sold	300
Value seed oysters sold	$180
Value market oysters sold	301,000
Bushels clams produced	22,000
Value of clams sold	$46,500
Principal market	New York.

Peconic Bay and Vicinity.

By act of Legislature in the year 1884, the jurisdiction of the lands under water in Gardiner's and Peconic bays, so far as the shellfisheries are concerned, was granted to the county of Suffolk. These waters have been found to be wonderfully well adapted to the cultivation of shellfish and, especially during the last few years, the industry has made a very rapid growth. Seed matures here with comparative rapidity, and the excellent stock produced has attracted many large planters from a distance and companies have been formed and equipped for working these lands. A very large part of the territory available for this business has already been appropriated. A considerable proportion of this stock is carried directly from Greenport to the New England States, quantities of the oysters being

opened before shipment. During the past year about 600,000 bushels were produced. This is a total greatly in excess of last year's production and demonstrates the progress of the industry at this favored locality.

Acres held under franchise	30,000
Total acres cultivated	15,000
Location of tracts—Great Peconic, Little Peconic and Gardiner's bays.	
Number gas and steam vessels employed	21
Tonnage of gas and steam vessels	645
Value of gas and steam vessels	$111,000
Value of outfit	3,150
Number of other boats employed	20
Value of other boats	$1,840
Value of outfit	1,520
Number of dredges used	84
Number of hands employed	210
Amount paid in wages	$94,500
Value of shore property	60,000
Bushels market oysters produced	600,000
Bushels seed oysters produced	100,000
Bushels seed oysters planted	250,000
Value of market oysters sold	$620,000
Bushels clams produced	1,200
Value of clams sold	$2,400
Principal market	New York and the New England States.

Great South Bay.

Considerable difficulty was experienced in obtaining statistics from this locality, and it has not been found possible to verify the returns closely. Many planters, however, and among them are the largest in the business, freely gave the desired information. A fair estimate shows a production of 780,000 bushels. The stock is sent to all localities by rail and by vessels. These oysters are the famous "Blue Points," and the price to the planter has averaged $1.50 per bushel.

Acres held under lease	1,493
Acres held under franchise	650
Total acres cultivated	1,426

Location of tracts—Great South Bay.	
Number gas and steam vessels employed	9
Tonnage of gas and steam vessels	118
Value of gas and steam vessels	$17,800 00
Value of outfit	4,200 00
Number of sail vessels employed	22
Tonnage of sail vessels	265
Value of sail vessels	$32,000 00
Value of outfit	2,000 00
Number other boats employed	2
Value of other boats	$1,300 00
Value of outfit	2,000 00
Number tongs used	60
Number dredges used	86
Number hands employed	171
Amount paid in wages	$58,950 00
Value shore property	14,800 00
Bushels market oysters produced	213,000
Bushels seed oysters produced	23,000
Bushels seed oysters planted	109,500
Bushels seed oysters sold	165,000
Value seed oysters sold	$140,000 00
Value market oysters sold	330,750 00
Principal market	New York and Europe

Long Island Oysters for California.

Four thousand two hundred and fifty barrels of seed oysters, an unprecedented quantity, were shipped to California from the following Long Island localities:

From Northport	3,700 barrels.
From Oyster Bay	350 barrels.
From Port Jefferson	200 barrels.

The seed from Oyster Bay and Northport was more than one-half grown and was used upon the Pacific coast to replace oysters of the same size which had been damaged by storms.

The stock sent from Port Jefferson was smaller seed to be used upon new grounds in the west. Unfortunately the Port Jefferson seed beds

were subjected to a violent storm and "sanded," thus preventing the shipment of larger quantities of stock. This seed sold for the phenomenal price of $1.25 per bushel.

The time required for the transportation of oysters to California has been greatly reduced, the oysters remaining out of water but fifteen days.

Newly Leased Lands.

During the year leases of land amounting to 1,629.6 acres have been granted. In addition to this, about 500 acres are in process of being leased, making an increase during the year of 2,129 acres which, added to the lands heretofore granted for shellfish cultivation, shows 30,000 acres of land under the waters of our sounds, bays and harbors (most of which was formerly waste land) now used in the culture of oysters and clams.

The New York Oyster.

The New York State oyster is a recognized patrician among bivalves; he is sought eagerly by all classes. Blue Points, Rockaways, East Rivers, etc., are shipped to all portions of the United States and Europe. The day of the specialized oyster saloon seems to be passing, but in lieu of that time honored establishment the butcher, grocer and general market man throughout our land are handling oysters. The taste for this delicious sea food is everywhere growing. It was lately said: "One who has a fondness for oysters to begin with never tires of the savory delights of a shell roast. With impunity and without a fear of ever growing sated or tired, one can eat oysters raw or oysters roasted in the shell 365 days of every year, with the added day in leap year."

Then why should we not raise more of them? Thousands upon thousands of acres under water, adjacent to our coasts, are admirably adapted to this crop and may be made profitable to the planter and become a boon to the masses. In the first annual report of the oyster commission of Louisiana, it is said:

"The commission finds that the oyster industry as it is carried on to-day, consists almost exclusively in an absolute dependence on the product of the natural oyster supply. The experience of other states, as found in the studies made by the commission, indicate this to be a most unwise policy. We know of no industry where dependence is had entirely upon the

YOUNG OYSTERS ON RUBBER SHOE.

natural wild product. We know that one acre of water bottom under cultivation will, at the very minimum, produce 100 barrels of oysters per annum, and we know further that the last annual oyster crop was less than half a million barrels. From this it conclusively follows that the total oyster crop of Louisiana for the past season could have been produced on a 5,000 acre oyster farm properly cultivated."

Questions concerning refrigeration of stock during marine and overland transportation are now practically solved, so that oysters may be carried great distances without the loss of freshness or of delicacy of flavor.

Shipments during the year from West Washington Market show interesting figures. The largest weekly shipments averaged 15,000,000 oysters. The smallest weekly shipments averaged 1,500,000 oysters.

Clams.

New York State clams are unsurpassed, the Little Necks being far-famed. They are especially in demand during the summer season when the supply of oysters is scarce. Greatly increased quantities of clams are annually demanded, causing the stock, during the past season, to bring phenomenal prices. The clammers, during the summer of 1905, received $2.50 per bushel for small clams, such as they had formerly sold for $1.25, and $5.00 per thousand for large clams which within two years they had been glad to sell at $2.50 per thousand.

Little Neck clams take to cultivation and crops may be raised by the planter with less risk than attends oyster culture.

Oddities of Shellfish Culture.

The young oyster is thoroughly impartial concerning the style of foundation he may have for the lime-walled tenant house which he intends to raise, so long as it is clean and hard. Mud and slime he cannot and will not endure. Though the oyster planter spreads out a bed of broken stone or of jingle shells to which the oyster may attach, still there are other objects upon the bottom of the sea, and it is not unusual to find a healthy growth of young oysters upon a rubber shoe, a brass lamp, a stick of wood, a glass bottle, etc. It is said that at the Smithsonian Institution in Washington, there is a specimen showing young oysters upon a set of false teeth. A

collection of these curiosities was sent by the writer to the St. Louis Exposition. Some photographs of the specimens accompany this article.

The Escallop Fishery.

The escallop fisheries of this State are located almost entirely in the easterly section of Long Island. In Little Peconic, Great Peconic and Gardiner's bays are found the best fishing grounds. The expanse of water through these bays is about twenty-five miles in length and of varying width. About two hundred boats of the sloop type, each carrying a crew of three men, are engaged in this industry and have earned an average amount of $600 each during the past (1904) season. The crop has been abundant and has sold for from $1.50 to $3.00 per gallon. The stock when raised is taken to shanties erected upon the shore, often in isolated situations, where the escallops are opened by the " pickers " who remove from each of the shellfish the adductor muscle which constitutes the edible portion of the escallop. The remaining parts are thrown away. The meat is then prepared for shipment and forwarded to market. Most of the stock is sold in New York city, though the failure of the 1904 crop in Rhode Island and other New England states created a new demand throughout New England for Long Island escallops. As a result, our friends to the northward of Long Island sound succeeded in obtaining a large portion, perhaps nearly one-half, of our Long Island crop. Occasionally escallops are found in other localities, but the great bulk of them, constituting the market supply, are caught in the bays named.

Sometimes a high wind, with its accompanying immense waves, will cast up vast quantities of escallops upon the beaches, where, at low water, they may be readily gathered by any one who cares to make the effort.

The escallops during the past season have been unusually large. A good " picker " will open from forty to fifty quarts a day, and is paid for this service six cents per quart.

It is estimated that the crop of 1904 returned to the fishermen the round sum of $200,000. An escallop attains a marketable size in one year. Though the crop of 1905 will be small, there is now found a good " set " which, if all goes well, will insure an abundance for the fall and winter of 1906.

Report of the Deputy Commissioner on the State Hatcheries for the year 1904

Hon. D. C. MIDDLETON, *Forest, Fish and Game Commissioner:*

DEAR SIR.—It is a matter of genuine satisfaction to me to be able to report that the State hatchery system, of which I have had charge under your direction, has fully maintained its high standing during the past year. Very effective work has been done in stocking our inland waters, and full appreciation of this has been shown by the fisherman. Thanks to the wisdom of the last Legislature in granting several necessary appropriations, many long-needed improvements have been begun, and the outlook for even better work during the coming year is excellent.

My object has been throughout to conduct the hatchery system on a strictly business basis, regarding it as a great plant for the purpose of producing a cheap and desirable food for the people. Taking this view of the subject, it becomes apparent that the plant will from time to time require improvements and extensions to meet the demands made upon it, just as would any other successful business enterprise. The main object in view, in my judgment, should always be effective work and a maximum product at the least cost possible, having always in mind the importance and extent of the requirements. During the past season the value of the fish distributed for the purpose of stocking the inland waters of the State was, at the lowest market price charged by commercial hatcheries, $119,684.67, which is a larger value than that of the previous season and secured without any great additional expense The detailed distribution for the year and the work done by each hatchery are fully shown elsewhere.

Some idea of the increase in the demands made on the hatcheries may

be had from the fact that during the past year we received 2,320 applications for fish of various kinds, as compared with a total of 1,908 applications received in 1903, and a total of 1,459 received in 1902. Of the applications received, we filled 1,929, as compared with 1,551 during the previous season, and carried over 196, which were filled satisfactorily during the late fall. We rejected 195 applications which were either defective, or duplicates, or called for fish not suited to the waters for which the application was made.

Owing to the severity of the previous winter, a considerable number of the fish had to be carried over until spring, which is the reason for the large increase in the number of yearlings distributed. As a rule the fish are planted chiefly as fingerlings, that being the size which gives the most satisfactory results. Should any yearling fish happen to be on hand they are planted only in the larger bodies of water, or in such streams as are closed to all fishing in the manner provided by law. Valuable assistance has been received from local organizations for the protection of fish and game in planting many of the inland lakes, and it is the intention to continue systematically the work of restocking the larger bodies of water on applications made in the name of the Commission itself.

As indicating the value of the State hatchery system in a manner which cannot be misunderstood, I quote from the recent report of Mr. John M. Cobb, Agent of the United States Fish Commission, who, in giving a detailed account of the commercial fisheries of the interior lakes and rivers of New York, says:

"The interior waters of New York produce more maskalonge and smelt than the waters of any other State in the Union, and they lead all others, except the Great Lakes, in the catch of bullheads, pickerel, wall-eyed pike (except Minnesota), yellow perch, and suckers. In 1895 the total catch was 754,730 pounds, valued at $60,068, while in 1902 it amounted to 1,530,918 pounds, valued at $87,897, a gain of 776,188 pounds and $27,811."

Undoubtedly, judging from the increase in our population and from the number of applications for fish as previously stated, the amount and value of the fish taken from the inland waters of the State have increased in a similar proportion during the past two years.

The Food Fish

For reasons not well understood, there were unusual difficulties last season, attending the highly important work of propagating what are classed in this State as "food fish." These difficulties, it has been learned, were also experienced in other states. In our own hatcheries the apparently healthy eggs, especially of the pike-perch, perished by thousands or hatched out weaklings without any reason that was apparent to the experienced men in charge. In the opinion of many fishermen the trouble was due to the unusually prolonged and severe weather of the winter preceding the spawning season.

The run of shad in the Hudson river was also much smaller than usual. Several snow squalls which came on during the season, chilled the water at various times sufficiently to check the run, but the fishermen also assert that the pollution of the river is now so great that the fish do not run in any great number far above Catskill. It has also been suggested that the myriads of carp which now infest the river seriously interfere with the spawning of this important species of fish, and a number of suggestions have been made by the fishermen with a view to overcoming these difficulties. One plan which has been urged is that the Commission take steps to raise the shad fry to a more advanced stage of growth before planting them. Another suggestion is that the Commission remove the shad hatchery from its present location on the banks of the river at Catskill to some desirable location on the banks of the Delaware river, either in the town of Hancock in Delaware county, or lower down in Sullivan county. The water there is practically free from pollution, and the fish run annually in great numbers. It would not be expensive to make this change and, in the judgment of experienced fishermen, a great many more eggs could be taken there and planted to much better advantage. As the failure of the shad fisheries is a serious matter, any reasonable experiment having for its object the improvement of existing conditions will recommend itself to the taxpayers.

It is encouraging to be able to report, while on this subject, that although some of the food fish did not hatch well, there was nevertheless a large increase in the output of several valuable varieties. The smelt did

particularly well at Cold Spring Harbor, and the highly-important whitefish exceeded in its output that of the previous season by more than 8,000,000. Arrangements perfected by the Commission, during the past year, will make it possible to procure a very much larger supply of eggs of the leading varieties of food fish for next season's work. The total output of all species of food fish for the season was 106,617,415.

The Game Fish

Although the primary purpose of the State hatcheries is always to keep the inland waters of the State well stocked with fish to meet the constantly increasing demands of the people for an ample supply of cheap and desirable food, considerable attention must also of necessity be given to the rearing of the so-called "game fish." In our State this classification includes only the several varieties of trout, but in other states the pike-perch is included. During the past season the output of trout exceeded that of 1903 by 584,499, and the grand total output of game fish was 5,045,914. The Commission was able during the year to restock many depleted streams for which applications were made by line fishermen, and also to supply an unusually large number of requests from citizens interested in public waters in many parts of the State. Apparently the severity of the winter did not affect the trout to any extent and good fishing was reported by those living in the very localities where the streams were said to have been frozen solid and from which doleful predictions came that the waters would be barren of fish in the spring.

The wisdom of the Legislature in making timely and encouraging appropriations for the use of the hatchery system rendered it possible for the Commission to so improve several of the hatcheries that their condition is now better than it has been before in years. It is believed that the extensions made at Margaretville will now render it possible to produce a supply ample for the stocking of the waters in the important Catskill region, and that changes made at the Pleasant Valley, Cold Spring and Fulton Chain hatcheries will result in more and better work at each. The great hatchery at Caledonia, and the very important trout hatchery at Saranac Inn Station, should have similar attention next season. It is also desirable that pro-

vision be made for the rearing of black bass, and the Commission has plans for this well in hand and will push them to a successful conclusion just as soon as certain questions involving the water supply can be settled. The demand for this species of fish has grown steadily for several years and is now so great that the importance of this work can no longer be overlooked.

A very serious epidemic among the brook trout at the Cold Spring hatchery, a misfortune which was shared by one or more of the great private hatcheries on Long Island, has temporarily removed this hatchery from active service. The Commission at the outbreak of this disease, communicated with Hon. George M. Bowers, the United States Commissioner of Fisheries, who promptly furnished one of his best experts to render all possible assistance. The matter was given the closest possible attention, but in spite of every effort not a single fish could be saved. The report of the expert on this epidemic is appended in the hope that it will be of service to fish culturists, should similar disasters befall elsewhere in the future. With a view to prevent any further occurrence of the kind at this important hatchery, the Commission has replaced all the old rearing ponds by cement structures and has thoroughly renovated all their connections. An entirely new lot of brood fish,— 12,000 in number, were sent to this hatchery from the Adirondacks during the fall, and it is believed that no further trouble will be experienced.

In connection with this hatchery it is regretted that the Commission has been forced, temporarily at least, to abandon the valuable work that was being done there in lobster culture. Excellent progress had been made in this work, and the great need for continuing it will be apparent to anyone familiar with the rapidity with which the lobster is disappearing from our waters. A considerable amount of lobster culture is being done by other states, and the condition of the work is well shown by the following letter, which was received by the secretary during the course of some inquiries made by him with reference to this subject:

COMMISSIONERS OF INLAND FISHERIES
OF RHODE ISLAND.

PROVIDENCE, *September* 28, 1904.

JOHN D. WHISH, *Secretary Forest, Fish and Game Commission, Albany, N. Y.:*

DEAR SIR.— Our Secretary, Mr. Morton, has asked me to write you a word concerning the results obtained in lobster culture and clam culture at the floating station of the Commission of Inland Fisheries of this State, located at Wickford.

We have, during the past summer, improved and extended our apparatus for hatching lobsters and rearing the young through the critical period of development. We have reared, by actual count, about 48,000 lobsters to the "fourth stage," or to the age of about two weeks. We also raised probably 30,000 which, through an accident to the apparatus, were liberated just before entering this stage. The percentage of young lobsters which were successfully raised to this stage was, in one experiment, 33 per cent., and in another 44 per cent.

In the first of these experiments, 20,000 newly hatched young were carefully counted and placed in one of the large canvas bags, and in the second 16,000. The work of counting so many lobsters is so arduous that only these two experiments were made for actual percentages. I think, however, that they represent fairly well the usual results.

Our lobster-rearing plant seems to have arrived at a practical stage, both as regards the proportion of yield and capacity. The method is comparatively cheap and capable of indefinite extension, and, comparing our results with those obtained in other countries, we feel that we are on the right track and are sanguine of greater success in the future. There are many evidences, from the increased number of small lobsters found in our bay, that the influence of the lobster hatching work is already beginning to be felt.

We have, also, during the past summer, planted many millions of small clams, grading from one-eighth to one-half an inch in length. Our previous experiments have demonstrated that, without question, clam culture is quite as feasible and practical as oyster culture.

In addition to these two lines of work, we have begun investigations of the fauna and flora of Narragansett Bay, of the life history of certain other food animals, of the new methods of hatching tautog and catfish, and have carried on some statistical work in regard to fish-traps and their catches.

Hoping that this may be of service to you, I am,

Very truly yours,

A. D. MEAD.

Very material assistance has been rendered by the United States Fisheries Commission during the past season, and thanks are due to the Hon. George M. Bowers, Commissioner, for his ready responses to our various requests. In this connection it may be said that in addition to the fish planted in New York State waters by our Commission the United States Commissioner has distributed:

1,148,000 brook trout fry,
3,375 brook trout yearlings,
4,470,000 lake trout fry,
10,900 rainbow trout fry,
1,850 black bass yearlings,
350 rock bass yearlings,
100,000 pike-perch fry,
15,235,000 whitefish fry.

In addition to its regular labors during the year, the Commission also had prepared an extensive exhibit of the food and game fishes of the State, both fresh and salt water, for the St. Louis exhibition. A complete list of these fishes is appended. An extensive exhibit was also made, as usual, at the State Fair at Syracuse, where it attracted much attention. For the benefit of those who have made inquiries about this exhibit, I have also appended a list of the fishes there displayed.

Thanks are due to the various railroads traversing the State, whose officials have kindly continued to furnish the Commission with free transportation for the distribution of fish from our hatcheries. This courtesy represents a saving of many thousands of dollars annually to the people of the State and makes possible a more thorough distribution of fish among our inland waters than could otherwise be had. That the railroads fully appreciate the value of the work of the Commission is indicated by the fact that the literature issued by them contains, as a rule, a statement that the various waters made accessible by their lines are stocked by this Commission and that good fishing is thereby insured.

Many letters have been received during the year which express satisfaction with the work of the Commission. Two which have been selected at random will sufficiently indicate their general tenor. They are as follows:

GREENWICH, N. Y., *September* 20, 1904.

Forest, Fish and Game Commission:

GENTLEMEN.—I wish to say a word of hearty approval for the work of your Department. For some years I have availed myself of the opportunities which it presents, and I can candidly assure you that most excellent results have resulted therefrom. Many old fished-out brooks have again become well stocked and now afford pleasant recreation and great satisfaction to the people of this locality.

Yours sincerely,

W. R. HOBBIE.

NEW LEBANON, N. Y., *August* 15, 1904.

Forest, Fish and Game Commission:

GENTLEMEN.—Referring to the stocking of the streams of this town, which your Commission has done upon the request of our people, it gives me pleasure to say that the results have been most satisfactory. Streams that heretofore were entirely barren have been amply replenished. Four years ago it was impossible to take any trout from the streams in this town. Possibly one or two might be had after a long tramp. Now the streams are well filled with fish, which one may see darting here and there while walking along the banks. It has been a matter of very great satisfaction to everybody interested to watch the results we have obtained here and I believe that equally good results have been secured elsewhere. The fish have always arrived in the best possible condition, showing how well they have been cared for by the men in charge.

Yours very truly,

S. J. TILDEN.

Another communication, which also expresses satisfaction with our work, and is in addition interesting in the showing it makes of the growth of one species of fish is as follows:

MIDDLETOWN, N. Y., *July* 15, 1904.

Forest, Fish and Game Commission, Albany, N. Y.:

GENTLEMEN.— * * * The rainbow trout planted by us in Shawangunk lake on July 10 to 15, 1902 (first planting) have grown to a wonderful size — out of all proportion to other fish planted anywhere around here.

Some have been taken during the past summer that were twenty-two inches long. During May and June, hundreds could be seen any day on the spawning beds, anywhere from ten inches to twenty inches long, the big fellows predominating.

* * * * * * * * * *

Very truly yours,

JOHN WILKINS.

In closing I wish to pay a merited compliment to the foremen in charge of the several hatcheries, whose strict attention to business and thorough knowledge of their work has aided materially in making possible the excellent results we have secured. It is my judgment that these men should be encouraged to do original work along the lines of their several activities, and for this reason I have appended an article on albino brook trout, which shows the result of an experiment conducted by Mr. Winchester, of the Adirondack hatchery, who has also collected, under the direction of the secretary, a very complete set of specimens of the eggs taken and fish propagated by the State. These specimens are arranged in an ingeniously constructed wheel, and are examined with great satisfaction by visitors to our office. It is suggested that many valuable specimens of interest to scientific workers can, from time to time, be gathered by the hatchery foremen and that valuable experimental work can be done by them without interfering with the business they have in charge.

Recommendations

In view of the preceding statements, and of other matters which have come to my attention during the year, I would make the following recommendations:

1. That an effort be made to have the committee of the Legislature, in their travels through the State, pay visits to the several hatcheries, for the purpose of giving these committees a well-defined idea of the magnitude of our work and its importance to the people, as well as of the requirements of the hatcheries.

2. That the location of the shad hatchery be changed in accordance with the suggestion and for the reasons already given.

3. That in recognition of the work done by the secretary in connection with the hatchery system, and more especially because of the interest he has taken in the distribution of the output, the collection of specimens for the various exhibits, and of his knowledge of the waters of the State and their requirements, the honorary title of Assistant Fish Culturist be bestowed upon him, and a suitable record of this action made in the minutes of the Commission.

4. That the State hatcheries be opened in a modified way to scientific workers engaged in the study of fish cultural problems, and especially to those studying the diseases of fish.

Respectfully yours,

J. D. LAWRENCE,

Deputy Commissioner.

ALBANY, *September* 27, 1904.

The Cold Spring Harbor Epidemic Among Trout

By M. C. MARSH, U. S. Bureau of Fisheries.

IN the spring of 1904 a heavy mortality set in among the older brook trout at the Cold Spring Harbor, N. Y., Station of the New York Forest, Fish and Game Commission, and continued until all the yearling and most of the adult stock had died, a total of some 12,000 fish. The death rate increased rapidly and on the average 40 to 100 dead fish were taken from the ponds each day, while at the height of the mortality, the daily loss reached 500. An effort to check the loss by transferring the trout to live cars in the salt water of the harbor only served to increase the death rate among the trout so moved.

The disease from which the trout were evidently dying was characterized, in most of the dying fish, by prominent external lesions, the chief of which was a shallow ulcer of circular or elliptical outline, and variously seated. This ulcer frequently involved the skin alone, sometimes eroded the muscular layers, seldom penetrated deeply and was not observed to perforate the abdominal wall. The cheeks and opercles sometimes showed bloody extravasations and ulcerative areas not sharply defined, while the fins and especially the caudal, were often frayed from the same ulcerative process. The region about the eye became the seat of inflammation, and occasionally the bone itself of the opercle had been slightly eaten away.

The typical ulcer of the disease, while sometimes almost perfectly circular and as sharply defined as if cut by a metal punch, was more often elliptical. When young and small it was often surrounded by a black border of pigment cells and large ulcers also sometimes were more narrowly dark edged. Old ulcers were more apt to show a pale border. The presumption

was at first that all the ulcerative lesions originated beneath the skin and involved the skin by eroding it in an ectal direction. This is certainly not always the case. The incipient ulcer may sometimes be seen as a shallow pit in the skin which had not yet been broken through to the muscle. In such cases it must have started either on the surface or within the skin.

During the latter part of the stages of the disease, ulcers were seen in a healing condition. A thin, smooth layer of tissue, full of pigment cells, but without scales, had proliferated over the bottom of the ulcer; and, without doubt, some few trout, at one time having a typical infection with the usual lesions, resisted the disease and passed to complete recovery.

The following estimations of hemoglobin in dying trout were made from samples of blood obtained by puncture of the dorsal aorta. The Dare hemoglobinometer was used. The readings are on a basis of 100 as representing normal human blood:

TOTAL LENGTH OF TROUT IN INCHES.	SEX.	HEMOGLOBIN.
8.0	Male	35
8.5	Female	46
7.5	Male	8
13.0	Male	47
10.25	Male	36
5.75	Male	31
6.5	Male	15
10.0	Female	27
		Average hemoglobin
		30.6

It does not appear from these readings that any marked anemia characterizes the disease. The average of the eight specimens is 30.6. Twenty readings of the blood of healthy domesticated brook trout of the Michigan Fish Commission, at Paris, Mich., average 35. There is quite a wide variation among individuals, apparently perfectly normal. Of the eight diseased

trout only two have a very marked anemia, while those with high readings showed the most extensive ulceration. It is probable that the disease reduces the hemoglobin only slightly if at all.

Bacterial culture media, inoculated from the blood of these trout, gave no evidence of bacterial infection. Besides the ordinary media, fish agar of alkaline, neutral and acid reaction was used, but the cultures in each case usually remained sterile. Occasionally a secondary invader was obtained, such as may not infrequently be found in trout weakened and dying from other causes.

To further determine the question of infection, direct inoculation experiments were made. Two aquarium tanks were used, each of about ten gallons capacity, supplied direct from its sources with cold spring water at about 57° F. Into each tank were introduced nine wild brook trout from four to eight inches in length, freshly caught from a natural pond above the hatchery grounds, and which had not previously been in any water on the station grounds. Each lot was fed with the regular station food, chopped beef hearts, and, in addition, one lot received on several occasions small portions of flesh containing the ulcers from the dying trout.

By the thirteenth day marked symptoms and lesions had developed among the trout which had been inoculated by feeding the disease ulcers. The largest of these, a male eight inches long, and which had been seen to consume the ulcerated tissue in quantity was without visible lesions, but respired at the rate of 120 per minute. The respiration of the largest control trout, a somewhat smaller fish, was eighty per minute. Of the others of the inoculated lot, seven showed external lesions, one a moderate exophthalmia of both eyes, two had sloughing areas upon snout, another an inflamed anal fin with sloughing of first rays and a slight protrusion of one eye, the others with slight bloody extravasations upon the sides. The trout with the sloughing anal had a respiration of 140 per minute.

On the fourteenth day, the largest trout of the inoculated individuals died with slight bloody extravasations about mandible. Its heart blood was sterile. On the sixteenth day, two others died, one with a typical ulcer, like those of the trout dying in the ponds, but much smaller. On the eighteenth day, another died, and on the twentieth day, two more, one of which bore several of the characteristic ulcers. On the twenty-second day,

the last trout succumbed, two having escaped from the aquarium during the course of the experiment. Of the control trout, three escaped during the first week and the remaining six were alive on the twenty-second day and quite without unusual symptoms or lesions.

In addition to the above experiment, an inoculation was made directly. Scrapings from the ulcers of the dead domesticated trout were implanted beneath the skin and within the muscle tissue of a wild trout about seven inches long. At the same time a control, five inches in length, was wounded in the same way, but somewhat more severely, and water injected into the wound. The inoculated trout died on the third day, the wound showing evidence of progression, and the membrane about the mandible showing a small inflamed area. The control remained alive and recovered from its wound. Wild trout were not available to make these inoculations on a considerable number, and the result, while suggestive, lacks conclusiveness.

Taken together, however, the results of feeding the ulcers and the direct implantation of material taken from them make it practically certain that the disease attacking the trout is some form of infection. The attempts to obtain bacterial cultures failing to furnish an organism, and microscopical examination corroborating, the probability of a protozoan infection is strongly suggested. The minute animal organisms which cause disease have not until very recently been grown in artificial media, and even at present, though cultures of the trypanosomes have been obtained, no methods of general applicability are available. The pure culture is the chief means by which the present extensive knowledge of bacteria has been obtained and its lack with protozoa curtails immensely the sources of information concerning them, and makes it practically impossible to demonstrate by inoculation the causal relation of specific protozoa to a given disease. Moreover, the resemblance of certain of the normal morphological elements of the tissues of the host to protozoan forms, adds to the obscurity of protozoan infection, and to the difficulty of diagnosis.

Nevertheless, fish disease due to microscopic animal organisms having a general distribution throughout the body, and, therefore, of the septicaemic type are recognized and several have been described from European

sources.* In this country a disease of brook trout upon Long Island has been ascribed to a hitherto unknown protozoan.† This was at Northport, and within about nine miles of the present outbreak. In external appearance, the marks upon the dying fishes in these two diseases were similar and created a presumption at the outset of their identity. At several other places on Long Island, epidemics have occurred during the past few years which are reported to resemble these, and it is not improbable that in the restricted region of this island the same causes are at work to produce among the many broods of trout which are there held in domestication severe epidemics attended with a high mortality.

Examination of fresh unstained tissues or blood, of the dying and dead trout, reveals practically no definite knowledge concerning the parasite. Neither are preserved and stained preparations easily interpreted. The balance of evidence points to the presence of Lymphosporidium truttæ of Calkins, and the disease is provisionally identified with that caused by this parasite. The reader is referred to Professor Calkins's paper (see reference) for the descriptions and illustrations of the organism itself, while some considerations will be here presented on the subject of infections in general among trout, the several causes which combine to produce an epidemic, and the measures which will lessen the chance of the recurrence of this disease in common with others of its type.

Trout have been for many years raised successfully and without serious losses at the Cold Spring Harbor Station, and, therefore, this outbreak of disease was the result of some unfavorable conditions which had not always obtained, or else of a culmination of such conditions continued back even to the beginning of operations. The water is of apparently excellent quality and has a normal content of dissolved air. There were certain unusual conditions prevailing previous to the outbreak which are of some value in considering its origin. A part of the station grounds including the larger ponds was flooded by the breaking of a mill dam during the spring, many trout were washed out to the harbor and much silt deposited in the ponds.

* Handbuch der Fischkrankheiten, Bruno Hofer, Muenchen 1904.

† Report on the recent epidemic among brook trout on Long Island. Gary N. Calkins, Fourth Annual Report, New York Fisheries, Game and Forest Commissioners, 1908.

It is conjectural just what relation, if any, this accident may have had to the disease. The deposit of earthy sediment in the ponds may have brought with it the infecting organisms, in which case it increased the pre-existing chances of infection, and perhaps determined the onset of disease at that particular time. It is not likely that it did more than this, for trout of proper resisting powers would not allow infection to gain a foothold within their own bodies, unless it were present in overwhelming amount. One must look for a deeper and more fundamental explanation.

The other unusual condition was the presence of a greater number of trout than usual within the pond space. It is the tendency of repeated seasons of successful experience in raising trout to maturity, to increase the scale of operations and make the same pond area and water flow bring forth a greater and greater product; in other words to overcrowd. Crowding is one of the necessary conditions of domestication, and it is of course domestication itself which is at bottom responsible for all these infectious epidemics which attack trout, as it is of most of the cases of parasitism and even of most of the losses among such fishes. The conditions making up domestication, which are a departure from nature, and which, despite the fact that such departures need not necessarily be unhygienic, are usually regarded as more or less unfavorable, may be divided into three, as follows:

1. Artificial, only slightly varied, diet.
2. Lack of range and exercise.
3. Crowding.

In addition to these, fish cultural waters frequently are somewhat, sometimes considerably, of a lower oxygenation than the natural habitats of fishes; and sometimes they have slight excesses of dissolved nitrogen, which are not sufficient to cause immediate trouble with the symptoms which higher degrees of the same excess cause, but which do have an unfavorable influence when long continued.

Taking the subject of domestication in a general way, and speaking in a broad sense, it is admittedly a fact that the intensive cultivation which it necessarily implies is accomplished at the expense of an increase of susceptibility to disease. This is in general true of both the animal and vegetable world. Confining the present consideration to fishes alone, and particularly to the trouts, one finds that while domestication protects them

against certain enemies it reduces their defense against certain others, and these are the bacteria and microscopic animal parasites. One may, moreover, cite a specific way in which this reduction of resisting powers is brought about. This is the anemia of domestication or lowering of the red coloring matter of the blood, as shown by estimation of the hemoglobin. Representing the normal red color of healthy human blood by 100, the average of thirty-five wild brook trout examined was found to be 43.7, and of wild rainbow trout from only two specimens, 92. Healthy domesticated trout of the same species average considerably lower, the brook about 35, the rainbow 54. In other words, domesticated brook and rainbow trout have poorer blood than the corresponding wild trout, and it is probable that the assertion applies to any trout, and in greater or less degree to most species of fish the subject of domestication. It may not be the mere falling off of hemoglobin which is immediately and alone responsible for attacks of disease; but it is well recognized that a high hemoglobin content favors immunity from the infectious diseases, and that a lessening of hemoglobin, causing anemia, is a lessening of bodily vigor. The hemoglobin of the blood is the oxygen carrier and interference with it is an interference with an essential life process.

Taking domestication in a more specific way and considering the separate conditions named to which bred trout are subjected, it is not always easy to see just wherein these operate to the disadvantage of the trout, save on the score that they are a departure from the natural conditions. Artificial food varies only within narrow limits and is of a sort that trout rarely or never get in their natural waters. While it meets the necessities of a readily available nourishing food, acceptable to trout, fish culturists will probably agree that a ration of natural living food, of various sorts, could it be supplied in quantity would be preferable. To a certain extent domesticated trout are deprived of the natural exercise which the mere capture of living food affords, and this, added to the narrow range permitted by the necessarily small size of preserves, must deprive them of an important muscular function and the reaction which comes from its exercise.

The third factor specified, crowding, is perhaps the most important of all and is the common and necessary evil incidental to any form of domestication in which a large quantity of product is the object. The maximum

crop is sought from the minimum of space. With trout this is of course a marked departure from the natural condition, and one in which its unfavorable influence with respect to disease is readily apparent. In the presence of the original micro-organisms of infection before any disease has occurred the chances of their access to the body of the fish are increased; and after they have become established in even one fish the chances of propagation of the disease by transferrence from fish to fish are enormously increased by the proximity of the individuals. It is in this respect that crowding has its most noticeable effect, though it is doubtless, in common with the other conditions mentioned, not without its indirect influence in preparing the way, in making a favorable ground, by a weakening of the resisting powers, for those very enemies whose first attacks and later spread it aids directly.

Crowding is here used in the sense of a proper, because necessary, concentration of fish in a given capacity of space and waterflow. The expression of this permissible concentration, numerically, for given area and flow cannot, at least has not, yet been made and as so many factors enter in, a simple general formula will probably not be obtained. Each fish culturist by his judgment and experience arrives at an approximation and with continued success it is easy to appreciate that he would be tempted to increase the number from year to year, while his water supply and pond area remain the same. Inevitably the danger line is sooner or later passed and the condition may be described as *overcrowding*.

With respect to Cold Spring Harbor the conditions of food, ponds, and water supply were much as they had been in the past, but the number of trout carried had been materially increased during the year preceding the outbreak of disease. Here then is believed to be an application of the principles above discussed, which are merely the extension to fish culture of already well-known laws recognized in the science of human disease. Other instances of trout epidemics following overcrowding are not wanting and will continue to come under the observation of trout culturists.

Among a stock of trout dying from this disease, or from any general infection, a considerable portion may usually be saved by transferring them to much larger quarters, as to a large natural pond of cold water or to a reach of a natural stream in which they may be retained by screens. This will not of course immediately put a stop to all loss among such trout.

Those far advanced in the disease will die, others will recover and the yet uninfected fish will be able to avoid taking up infection. These results are brought about both by diluting the infection and by an increase of resisting powers due to the natural conditions. A shallow stream of rather rapid flow is of course more favorable than a sluggish one.

No one measure or single specific can be recommended as sufficient to insure with certainty against this and similar diseases, nor to prevent with certainty their recurrence. Avoidance of overcrowding is necessary, is a condition precedent to freedom from such diseases. The positive measures which are practicable and which decrease the chances of infection relate to disinfection in connection with impervious pond construction. Disinfection of ponds consists in killing the organisms of disease which, especially during and after the course of the disease, are located within the ponds. If they are of wood, earth or gravel or any permeable material, the difficulty of disinfection is increased and it is not easy to make sure of its thoroughness. If of cement, or masonry with a cement finish, both sides and bottom, the organisms have only a free exposed surface upon which to locate and here they may be readily reached and killed by various chemical agents. Such ponds doubtless protect to some extent from the original access of infection, from the first attack which will come sooner or later to most trout ponds, but their chief value will probably lie in preventing a given attack from continuing by secondary infection during the succeeding seasons. A pond which is water tight should be capable of holding fish again, even after its fish have all died of infectious disease, with as little chance of a repetition of the loss as existed before any disease occurred in it. This requires, of course, a rather careful and thorough application of a powerful germicide and subsequent thorough flushing to completely remove the substance used. A number of such substances are efficient disinfectants, but since a considerable quantity must be used, cheapness is an important consideration. Slaked lime or quick lime are not sufficiently effective and should not be used. Chloride of lime is to be recommended. In its application or that of any disinfectant, it is essential that the flow of water be stopped or reduced to a very small volume. The chloride of lime may then be scattered over the bottom and enough water admitted to allow the bottom and sides to be scrubbed and washed down thoroughly with the solution resulting. In a

pond 40x10 feet and containing water to the depth of one inch not less than twenty pounds should be used. The sides should be kept constantly wet with the liquid for an hour or more and the pond may stand over night with the flow cut off. The water should then be turned on and no fish introduced until the chloride of lime is thoroughly flushed away. This substance, even in considerable dilution is fatal to fishes and may kill many in the stream into which the ponds drain, and for a considerable distance below the point at which their drainage enters. This may be obviated by reducing the rate of the flushing process.

Copper sulphate is extremely fatal to certain minute forms of vegetable and animal life, especially the bacteria, and in some cases is effective in very great dilutions. The least concentration of any disinfectant fatal to the protoza of trout disease is unknown and, therefore, the quantities just sufficient cannot be stated. Sufficient must be used to make a probable excess, a solution in which no forms can reasonably be supposed to long survive. Notwithstanding the high toxic power of copper sulphate for some forms, it is not known that for the purpose under consideration it would be any more effective than the chloride of lime, and its cost is about double that of the latter. If for any reason it is more available it may be used in the same proportion as the chloride of lime. It is highly toxic to brook trout. Domesticated fry of a length of two to two and one-half inches are killed within twenty-four hours by one part of copper sulphate in 6,000,000 parts of water. Older trout are somewhat more resistant. The precautions when flushing off the disinfectant are even more important than with chloride of lime.

Of course a pond may be disinfected when full of standing water by adding correspondingly larger amounts of the disinfectant. Wooden or earth ponds may be treated in either of the ways described, but with less likelihood of a thorough disinfection. The subsequent washing out should be more prolonged than with a cement pond.

At the beginning of this investigation a number of determinations of the dissolved air in the station water supply was made. These were undertaken partly because the apparatus for the purpose was available, and partly for general data on fish cultural waters in this respect. No air defects were indicated by the disease in progress. The results are of considerable interest and are as follows:

Dissolved Air in Water Supply of the Cold Spring Harbor Station in Cubic Centimeters per Liter of Water, the Gas Reduced to 0° C. and 760 mm. Pressure, Dry.

SOURCE OF WATER SAMPLE.	Temperature Centigrade.	Carbon Dioxid.	Nitrogen.	Oxygen.	Normal content of pure water when saturated with air at the given temperature.		Excess+ or Deficit—.	
					Nitrogen.	Oxygen.	Nitrogen.	Oxygen.
Spring at edge of Reservoir pond	9.5	4.7	15.73	6.71	15.5	7.96	+0.23	—1.25
Factory pond	11.0	1.6	14.9	6.79	14.74	7.69	+0.16	—0.9
Middle of Reservoir pond	13.0	0.71	14.65	10.46	14.47	7.35	+0.18	+3.11
Same, second determination, one day later	11.0	1.7	15.63	10.85	15.06	7.69	+0.57	+3.16
South end of Reservoir pond	12.0	4.0	15.47	6.8	14.80	6.09	+0.67	—6.71
Reservoir pond at intake for hatchery	11.0	2.3	15.30	8.01	15.06	7.69	+0.24	+0.16
First fry pond	11.5	1.2	14.83	7.74	14.90	7.55	—0.07	+0.14
Second row of fry ponds	11.5	1.1	14.77	7.88	14.90	7.55	—0.13	+0.28
Inflow at south end of fry pond	10.5	2.6	15.04	7.01	15.20	7.78	—0.16	—0.77
Lower pond for adults	12.5	1.5	14.51	7.29	14.62	7.43	—0.11	—0.14
Jones artesian well	11.0	3.6	17.12	6.6	15.06	7.69	+2.06	—1.09

As for oxygen, which is that portion of the atmosphere which after solution in the water plays an essential part in the life process of fishes, the Cold Spring Harbor water is in no case lacking an abundant supply. It is not in every case quite saturated with oxygen, that is, does not contain all that is capable of holding at the temperature existing and at atmospheric pressure; but the deficiency is slight. In the middle of the "reservoir pond," however, which is practically a large spring, its condition is rather remarkable and unusual for natural waters. Is is supersaturated with oxygen, the excess being more than three cubic centimeters per liter of water, and consequently oxygen must be passing from the water into the atmosphere. The source of

this excess is doubtless a thick growth of algæ, chiefly a Spirogyra, which lines the bottom of the pond throughout a large part of its extent, but is heaviest about the middle. The algæ during daylight absorb carbon dioxid from and give off oxygen to the water. Just what effect an excess of dissolved oxygen has upon fishes is not known to the writer and is an interesting field for study. But this effect is presumably injurious. A number of adult trout were contained in the reservoir pond in question at the time of the observations and were in good condition, but they had access to all portions of the pond and in some of these no excess of oxygen existed as will be seen by a reference to the table. Conclusions from these fish are not therefore of much value.

The excess was not great and was speedily dissipated, or very nearly so by exposure to the air, so that by the time the water reached the nursery and other ponds the oxygen content had fallen almost to the normal. It cannot be said to have any bearing on the disease.

Probably no natural waters are known to ever contain a deficiency of dissolved nitrogen, but they may have an excess of this gas and this condition is inimical to fish culture. An excess of three or four cubic centimeters per liter is sufficient to cause death with marked symptoms and one to two centimeters will probably cause trouble though not necessarily with immediate heavy loss. The Cold Spring Harbor waters have no excess of any practical significance. Each sample of water taken close to its origin from the earth, as the reservoir pond samples, does show a slight supersaturation with nitrogen, in no case higher than 0.67 cubic centimeters per liter. A considerable quantity of nitrogen gas is held mechanically in the gravelly bottom of this pond, and this is probably responsible for the condition. In every case where the same water has been examined after a thorough exposure to the air, as in the fish ponds themselves, the nitrogen excess has been completely removed. The figures in fact show a very slight deficiency but within the limits of error of the apparatus used in the determinations, and all such samples may be regarded as saturated. While, then, there is no nitrogen defect in any of the station water when used for trout in the fish cultural ponds proper, the water of an artesian well, ninety feet deep, not far from the station grounds shows an excess of over two cubic centimeters per liter, and would not be suitable for fish culture without deaeration by thorough

exposure to the atmosphere. Similar wells driven upon the station grounds would be apt to have a similar excess of nitrogen. If their flow rose several feet above the ground their water might be successfully deaerated into a proper fish cultural condition.

It is natural that the salmonoids, containing the most active, nervous, highly-organized species, preferring the cold, well aerated running streams, plenty of room and a predatory existence, should be most susceptible to disease when brought together in large numbers. That the brook trout is more often attacked by disease than any others of the family is in part due, of course, to the fact that it is more extensively cultivated. Yet there seems to be no doubt that it is intrinsically more susceptible to general infections than other trouts. It will, for instance, succumb to conditions which do not affect the rainbow, though living side by side with it. The factor of safety in the culture of brook trout is a rather narrow one. At least occasional heavy losses will continue to attend their concentration in large numbers. This is a tax on trout culture which may be paid either in dead trout or in some sacrifice of the magnitude of operations. Reduction of numbers — avoidance of overcrowding — is the most important measure of prevention.

Report on the State Hatcheries for the year 1905

Hon. James S. Whipple, *Forest, Fish and Game Commissioner:*

DEAR SIR.—Better work than ever before has been done by the State Hatcheries during the season of 1905. The improvements made possible by the appropriations, given by the Legislature in response to urgent demands a year ago, have been used to great advantage in making necessary repairs and extensions. It is hoped that a spirit of continued liberality will prevail, since the requirements of the Commission, in order to meet the constantly increasing public demand, are such that a considerable enlargement of the hatchery facilities is imperatively necessary. Not only should the space alloted to rearing fish be materially increased, but the buildings now on the hatchery grounds should be kept in good repair It should be stated in this connection that much of the repair work, and practically all of the painting necessary, can be done by the hatchery employees without additional expense, beyond the ordinary cost of materials needed.

One of the features of the past year, in connection with the hatchery work, has been the increased interest shown by fish and game clubs in various parts of the state in the distribution of both food and game fish. In many cases these clubs have laid out well advised plans for stocking the waters in their territory, and, in all cases where such organizations have applied for fish, they have attended to the distribution in a praiseworthy manner. Careful attention has been given to the wants of the clubs and they have been advised in many instances as to the fish best suited to the waters to be stocked and the proper number to be planted.

All the information received indicates that the season has been highly satisfactory to the line fishermen. Although the weather conditions were

not always favorable, the trout fishermen in particular had excellent success, and the number and size of the fish taken will compare favorably with those of any season in recent years. I find all the more satisfaction in this statement from the fact that conditions affecting the trout were not in all cases satisfactory at our hatcheries. The trouble at the Cold Spring Harbor Hatchery, reported at length last season, was again in evidence and destroyed the large number of wild trout with which we endeavored to restock the brood ponds there. This matter is treated in detail in the report of the foreman in charge. Serious difficulties were also experienced at the Pleasant Valley Hatchery which are reported fully elsewhere. Correspondence conducted by the secretary shows that we were not alone in these difficulties, but that large numbers of fish of various kinds were lost in other states and that these epidemics are not confined to hatchery waters. The extent to which the commission has reared and distributed brook trout is shown in an appended table.

Considerable more work than usual was done during the past season in connection with the United States Fisheries Commission, and our thanks are due to Commissioner George M. Bowers for many courtesies. A large number of food fish were hatched from eggs furnished by him, and planted by our hatchery employees in the Great Lakes. This work is of much value in maintaining the supply of food fish in these waters, and is highly appreciated by the commercial fishermen.

The extent of the work done in connection with the United States Commission may be judged from the fact that we planted

266,090 brook trout fry,
503,275 lake trout fry,
7,000 rainbow trout fry,
1,000 steelhead trout fry,
600 land locked salmon fingerlings,
2,805,000 whitefish fry,

a total of 3,582,965 fish furnished directly from the Government hatcheries.

Besides this, on the request of individuals indorsed by Representatives in Congress, the United States Commission planted in various waters in New York State during the past year, a total of 31,689,160 fish of various varieties, thus divided:

Brook trout fry	530,000
Brook trout fingerlings	3,700
Lake trout fry	4,876,000
Rainbow trout fingerlings	800
Steelhead trout fry	24,700
Land locked salmon fry	4,800
Black bass (l. m.) fingerlings	3,860
Rock bass, fingerlings	150
Pike perch fry	4,050,000
Yellow perch fry	750,000
Crapple, fingerlings	150
Whitefish fry	21,445,000

The details of this plant will be found elsewhere, giving the waters and the allotment to each.

Valuable assistance was also rendered as usual by the railroads, whose free transportation of fish from the State Hatcheries, and of the necessary messengers accompanying them, has made it possible for the Commission annually to distribute the output of the State Hatcheries to our inland waters for the benefit of the people.

Thanks have been received from the State Fair officials for the unusually large exhibit made by the Commission last season. The valuable collection of fish, by which the Commission was represented at the St. Louis and Portland Expositions has been returned to our care and, with the collection of birds and animals, now forms an attractive exhibit in the Capitol corridors. It is examined daily by many visitors, and is not only a source of satisfaction to sportsmen, but is also an important source of information to hundreds of children from the nature study classes in the public schools. If several additional cases could be procured, the exhibit could be displayed in a much more satisfactory manner.

That the work of the State Hatcheries has been as highly satisfactory, as has been stated, will readily be seen by an examination of the appended tables. The increases shown in the several species of fish represent hard work done by the hatchery employees, to whose faithful attention to their arduous labors due credit should be given. The total number of applications for fish received during the season of 1905 was 2,216. Of this number 2,021 were filled, 145 were rejected for various reasons, and 50 will be car-

ried over to the next season. The total value of the fish distributed, estimated according to prices furnished by commercial hatcheries without reference to cost of transportation or messengers was $152,781.60 as against $119,684.67 in 1904.

The Maskalonge

Considerable discussion has arisen in recent years as to the falling off in the catch of maskalonge in Chautauqua Lake. The State Hatchery, located on this lake at Bemus Point, has annually planted millions of fry there, but the result does not seem to be all that is desired. Many residents of the locality, who are ardent fishermen but are without accurate knowledge as to the difficulties which the problem presents, have insisted that the State should raise the maskalonge fry to the fingerling stage before planting. Experiments with the fry have shown conclusively that this species cannot be so raised on account of the very great voracity of the young fish. The Commission has endeavored by enlarging and improving the hatchery at Bemus Point to solve the problem by holding the young fish as long as possible before planting, and it is hoped that the effort will result satisfactorily.

During the fall, attention was called to the fishing at Chautauqua Lake by a paragraph in a local paper which stated that Mr. John Peterson of Jamestown, had caught a maskalonge, weighing over forty pounds. The Secretary of the Commission, who has been giving close attention to the stocking of inland waters, wrote to Mr. W. H. Knapp, Secretary of the Sportsmen's Association of Chautauqua County, for information as to the large fish and also for general information about the fishing in the lake. The following reply was received:

JAMESTOWN, N. Y., *October* 20, 1905.

Forest, Fish and Game Commission, Albany, N. Y.:

GENTLEMEN.— The fish in question was caught in Chautauqua Lake on a trolling rig and its weight was 38¾ pounds. This was, I believe, the largest fish taken this season. A friend of mine got one weighing 32¼ pounds while trolling, and several were caught that weighed over 25 pounds

each. I was favored with a 15½ pound fighter and landed him successfully with a 10 oz. Bristol rod. He made royal sport.

As a whole the fishing during the past two seasons has been very poor. I think it was worse this season than last. We do not get many small maskalonge of late years, showing that there is some grave depreciation in the fry. Some claim that the hatchery is a failure. Others say that the carp and bullheads eat up the spawn and destroy the beds. We feel as though the State should give us some aid in getting rid of the carp. These fish were let into the lake about fourteen years ago by the breaking of a private dam. Since then they have increased to an alarming extent. If something is not done to exterminate them they will run the other fish out. Is there not some way to remedy the evil?

It is an acknowledged fact that the catch of 'longe has been getting less each year for the past six or seven years. I attribute this mostly to the infamous spearing law which we were successful in getting repealed last spring. Old fishermen claim it will take ten years for the lake to recover. This lake is full of food and all the bass and maskalonge taken are hog fat. We have put in two batches of pike perch — are they a good fish for this lake, and how will they affect the bass and maskalonge?

The fishing in the other lakes in the county has also been poor. A twenty-eight pound 'longe was the largest heard from at Bear Lake with several that weighed ten and twelve pounds each. Findley's Lake furnished some, and the largest I heard of weighed a little over twelve pounds. I am always pleased to give the Commission any information I can and hope you will call upon me whenever you want anything.

Very truly yours,

W. H. KNAPP,

Secretary.

What the Commission has done for Chautauqua Lake in the way of endeavoring to keep up the maskalonge fishing may be judged from the stocking record. During the ten years beginning with 1896 and ending with 1905 the number of eggs taken, of fry hatched, and the plant in Chautauqua Lake and in other waters has been carefully kept and is shown by the following table:

YEAR	EGGS TAKEN	FRY HATCHED	FRY PLANTED IN THE LAKE	FRY PLANTED IN OTHER WATERS
1896	4,130,000	1,815,000	1,000,000	815,000
1897	5,660,000	3,075,000	1,815,000	1,260,000
1898	6,720,000	2,650,000	900,000	1,750,000
1899	10,020,000	4,860,000	3,055,000	1,805,000
1900	6,800,000	4,490,000	3,290,000	1,200,000
1901	7,560,000	4,520,000	2,370,000	2,150,000
1902	3,820,000	2,210,000	1,090,000	1,140,000
1903	6,846,000	4,107,600	2,382,600	1,725,000
1904	5,428,500	3,257,100	957,100	2,300,000
1905	5,061,000	2,025,000	1,000,000	1,025,000
Totals	62,045,500	33,009,700	17,859,700	15,150,000

It is my judgment that a special study should be made of the problem presented by Chautauqua Lake to the end that a satisfactory answer may be given to the complaint which is voiced in Mr. Knapp's letter. The figures given in the table show that the lake has been treated with unusual fairness by the Commission, and that it is not from any lack of returning to the water a proper porportion of the fry hatched from the maskalonge eggs taken that the falling off in the take of this fish has occurred.

An interesting account of an experiment in raising the maskalonge fry to the fingerling stage is given in another place and will no doubt be instructive to all those concerned in keeping up the supply of this fish in Chautauqua Lake.

Hudson River Shad

By far the most serious problem confronting the Commission is presented by the failure of the shad fisheries of the Hudson River. For years this body of water was one of the most important in the country on account of its prolific run of shad and herring. But within the past ten years, at least, neither of these species of fish have appeared in anywhere near the

usual number. It would seem as if, year after year, the run of fish was retarded by an invisible line which annually stretched further and further down the river, and beyond which the fish would not pass. Formerly, shad were caught up to the Troy dam. Then the fish were sold for a very small price in the streets of Troy and Albany. Later they became scarcer and scarcer until, at present, the fish do not seem to run very much above Hudson. There has been no lack of stocking this water both by the State Commission and by the United States Commission, but the results have failed to meet the anticipations of fish culturists. It is a notable fact, in this connection, that during recent years the Hudson River has become little more than an open sewer, and each year finds the conditions in this respect worse than the year before. It is the judgment of those who have considered this matter seriously that the fish will not run up beyond a certain limit of contamination in the water. Several years ago the fishermen themselves figured out the situation and reported it to the Commission. Very recently the author of a book devoted entirley to the Hudson River says with reference to this body of water " There can be little doubt that fish are poisoned by the fouling of the elements in which they live," and another writer says " Everywhere, the country over, streams once yielding a bounteous supply of fish have long since been utterly and permanently ruined by having been converted into sewers for refuse which destroys all life."

I have given particular attention to this problem because of the importance of the shad as a food fish, and when my attention was directed to the reports of the Connecticut Commission by our secretary, I instructed him to examine into the conditions prevailing in the Connecticut River, and the methods adopted by the Connecticut Commission to meet the situation. His report advises me that their shad fisheries gradually failed year after year until, in 1892, they amounted practically to nothing. The outcry of the fishermen was such that the Commission of that State made a careful study of the situation and determined that the pollution of the water was such that the eggs deposited naturally were smothered, and the fry which did hatch were unable to withstand the condition of the water. After considerable experiment the Connecticut Commission decided to try to

raise the fry to the fingerling stage, in the hope that the larger and stronger fish would be able to withstand the condition of the water. In 1895 the Connecticut Commission secured an old water privilege on Rams Horn Creek at Joshuatown, and spent $4,500 in building a dam and repairing two dams that already existed on the stream. Three ponds were thus created,—the upper one containing seven acres, the middle one containing three acres, and the lower one containing five acres. Each pond was cleaned out and the bottom sloped toward the creek which naturally ran through them to the river, and at the outlet of the lower pond screens were put in so as to prevent the fish from passing out until, in the judgment of the Commission, it was best for them to do so. The outlet of the lower pond is but a few hundred feet from the river itself, and the ponds are located about ten miles from the mouth of the river. An average of 3,000,000 fry are annually placed in the three ponds, and are fed with crushed crackers. The fry are held until the latter part of October when they would naturally run down the river to the sea, and the gates are then raised, and the contents of the three ponds are released. By this time the shad are from two and one-half to four inches long, and are strong and active fish. Good results were obtained from this experiment within three years after the ponds were first drawn off, and in 1904 the fishermen caught 172,000 large shad as compared with a catch of but 18,000 a few years before.

In correspondence with our Secretary, Mr. E. Hart Geer, Secretary of the Connecticut Commission, says relative to this experiment:

"Prior to the establishment of the retaining ponds, the run of shad in the Connecticut River decreased each year, notwithstanding the millions of fry planted at various points. We have found in our experience that the fry are very susceptible to the slightest contamination of the water, and that, when they have to pass through water filled with sewage on their way to the sea the result is fatal to them. By raising the fry to fingerlings, which at six or eight months old have grown to be two and one-half to six inches long, we find that they are abundantly able to stand the pollution of the water and to take care of themselves against their common enemies. We are confident that a supply of shad in the Connecticut River can be maintained only by placing the fry in ponds where they can be held until they are at least six months old. Every fisherman on our river recognizes this fact, and appreciates the benefits which have followed the adoption of the plan."

It is my judgment, in view of this letter and the report made to me by our Secretary, that we ought to try the experiment of rearing shad to the fingerling stage, and I very sincerely hope that the next Legislature will appreciate the situation and aid us by an adequate appropriation.

Possibly, in addition to the general contamination of the river, we will have to consider the inordinate use of nets at its mouth and the very great pollution which there exists. Nevertheless, if it is possible to overcome the factor of pollution, which in my judgment seems to be the most serious obstacle, we may be able, by adopting the Connecticut method, to restore to the Hudson River the valuable shad fisheries which of late years have entirely failed. Following is a table showing how extensively the State Commission and the United States Commission have stocked the Hudson River with fry during the past ten years.

YEAR	FRY FROM STATE HATCHERY	FRY FROM U. S. COMMISSION
1896	4,095,000	4,595,000
1897	3,018,000	7,125,000
1898	6,579,400	5,500,000
1899	2,113,800	11,470,000
1900	2,870,200	10,280,000
1901	4,806,600	13,156,000
1902	3,911,150	2,123,000
1903	3,119,900	.....
1904	1,518,500	3,000,000
1905	2,361,900	.....
	34,412,450	57,249,000

These figures show a total plant during the ten years of 91,661,450 fry in good condition. The records for twenty years prior to 1896 prove moreover that both the State Commission and the United States Commission have given the Hudson River continuous and careful attention, and have planted millions upon millions of shad fry in its waters.

I repeat my recommendation of last year, that legislative committees be urged to visit the State Hatcheries while on their trips through the State in search of information. As the Caledonia Hatchery is easy of access and

produces a variety of fish, I would suggest that it be made the center for such visits. I also suggest that careful attention be given to the question of placing fishways in dams. It is no great hardship to build a fishway, and one of the approved pattern recommended by the United States Commission should be placed in every dam which blocks the way of fish seeking to run up stream to spawn.

Respectfully yours,

J. D. LAWRENCE,

Deputy Commissioner.

ALBANY. *September* 30, 1905.

Report on the State Hatcheries for the year 1906

Hon. J. S. WHIPPLE, *Forest, Fish and Game Commissioner:*

SIR.—You are already advised, in a general way, as to the very great advances made in the work of the State Hatcheries during the past year, and it but remains for me to call your attention specifically to existing conditions, and to describe where necessary the work that has been done, and to make such suggestions as have occurred to me for the betterment of the service. The commendable liberality of the Legislature, to whose attention the requirements of the hatcheries were called last season, has had its effect. The result should amply warrant the further attention of the law making body until appropriations fully adequate to the necessities of fish propagation and distribution are procured. There is no apparent reason why the State Fish Hatcheries should not be kept up to as high a standard as private property would be, and there are very many reasons why every dollar asked for the improvement and enlargement of these hatcheries should be given. If the Legislature would, as has been many times suggested, send a committee to look into the hatcheries and their work, and to note the increasing demands made upon them, there would be no doubt as to the result of an application on the part of this Commission for funds for hatchery purposes.

The distribution of fish during the year just closed has been far greater than ever before. A total of 225,909,360 food fish have been raised and distributed, as compared with a total of 164,930,400 during the previous year. At the same time, the total output of game fish has been 9,764,900 as compared with 6,540,620 the year before. The very substantial increase in each case is at once apparent. This great increase is in part due to enlarged facilities made possible by the increased appropriations furnished

in response to your urgent request a year ago, and in part also to the benefits derived from the scientific management applied to the hatcheries by the State Fish Culturist, Dr. Tarleton H. Bean. To him is due the credit of preventing any considerable loss among the fish from the usual diseases which prevail in hatcheries, and which have in the past in many cases very seriously reduced the stock we have had available for distribution.

From many localities reports have come which indicate not only satisfactory, but in some cases, surprising results derived from stocking depleted waters. One notable instance is found in the St. Lawrence river, where the supply of maskalonge had been decreasing for several years to the great dissatisfaction of the thousands of visitors to this favorite vacation region. The work of restocking this river was taken up vigorously by the Commission with the aid of individual citizens and particularly of the Anglers' Association of the St. Lawrence. Without going into any further detail, it may be said that the result has been most gratifying, and that the fall fishing last season was the best in years. The fishermen concede that this is directly the result of the work done by the Commission, and the local newspapers have been liberally supplied with accounts of satisfactory catches. One of these items which appeared under date of November 9 last, was as follows:

"All records for maskalonge fishing on the St. Lawrence river were broken last Monday, when Steve Norton and George B. Hartman returned home from a fishing trip up to Eel Bay. The boys left their homes at Alexandria Bay last Saturday night for Eel Bay, where they fished two days. On Sunday they were unable to get a fish of any kind, but on Monday they started out very early and had good luck in breaking all records for maskalonge fishing. They captured seven of them, the total weight being 128 pounds. The fish weighed separately 12, 14, 14, 15, 15, 28 and 32 pounds respectively."

This catch was photographed and the picture is reproduced herewith, showing the fish as they appeared soon after being taken from the water. Protector Joseph Northrup, of Alexandria Bay, who forwarded the photograph to the office, wrote at the same time: "We are satisfied that the good fishing comes from the stocking that the State has been doing for sev-

eral years past. There have been more fish caught in the river this season than in years before."

Local incidents of this kind serve an excellent purpose in calling attention to the very great importance of the fisheries of New York State. According to the carefully collected statistics of the United States Bureau of Fisheries, New York State is easily the first of the middle Atlantic States in the extent and importance of its fisheries. This fact alone should impress itself upon our Legislature when matters connected with the hatcheries, which keep up the supply of fish in our waters, are brought to their attention. Millions of dollars are invested in the fishing interests, and upwards of 12,000 people in this State secure a livelihood from this business. It is estimated that the total catch of all kinds of fish in our waters, on an average year, is about 300,000,000 pounds, which have a cash value of over six and one-half millions of dollars. This, briefly, is what our fisheries mean to our State, and the success of these fisheries, beyond a doubt, depends very largely, if not almost entirely, upon the work which the State Hatcheries do in keeping up the supply in our waters.

The actual work of the hatcheries may be readily understood by a comparison of the number of applications received for fish and the disposition made of them during the year. In 1905 the total number of applications received for all kinds of fish was 2,216. During the past year we have received a total of 2,591. Of these, 2,424 applications were filled promptly, 123 were rejected for various reasons (100 for trout, 20 for pike, and 3 for maskalonge), and 44 were carried over for next season's work. The number rejected a year ago was 145, we carried over 50, and the total number of applications filed was 2,021.

Rather more than the usual attention was given to the exhibit at the State Fair, and as a result the Commission received many compliments for the display made. The fish were all in good condition, and the variety shown included examples of all those most commonly met with by our fishermen. As usual, at the close of the Fair the fish were distributed in nearby waters.

From the United States Commission we received a total of 5,000,000 whitefish eggs, 4,250,000 lake trout eggs, 5,000,000 pike perch eggs, and 170,000 brook trout fry during the year. The eggs were hatched and the

resulting fry for the most part distributed in the Great Lakes, in accordance with our agreement with the Federal authorities. In this way our State co-operates with the government in keeping the Great Lakes stocked for the benefit of the fisherman. It is sincerely to be wished that some arrangement could be made whereby these fishermen would stop taking fish in these waters during the spawning season. If the fish in the Great Lakes were allowed to propagate naturally, it would materially help to keep these waters stocked.

In addition to the unusually large number of fish of various kinds distributed from our hatcheries, large numbers were secured also by individual citizens from the United States Commission through the representatives in Congress from this State. In 1905 the total number thus secured was 31,689,160 fish. The total secured during the year 1906 was 29,529,120, which was made up as follows:

Brook trout fry	115,000
Brook trout fingerlings	7,900
Lake trout fry	2,124,000
Small mouth black bass fry	28,400
Small mouth black bass fingerlings	4,220
Large mouth black bass fingerlings	5,400
Land locked salmon fingerlings	1,800
Pike perch fry	2,700,000
Yellow perch fingerlings	125
Crappie fingerlings	200
Rock bass fingerlings	125
Bream	150
Whitefish fry	24,541,800

These fish were distributed in the various lakes and streams of the State in the manner shown by the detailed statement given elsewhere. The government also furnished 799,000 eyed eggs of various kinds, most of which went to the New York Aquarium, where a miniature hatchery is conducted for the instruction of visitors. The fish hatched from these eggs were turned over to this Commission for distribution in nearby waters.

Not much was done to net out fish from the falling waters of the canal for reasons given in last year's report. It should be noted, however, that

there were thus saved during the latter part of last season, which were not included in the 1905 report, a total of 1,482 fish. Those included 370 adult small mouth black bass, 800 adult yellow perch, and 312 adult bullheads. The bass and perch were placed in Owasco lake. In addition there were also taken out of the canal 466 suckers, 783 carp, and 294 dogfish.

I have no recommendations to make further than to urge that the work of hatchery improvement and extension be kept up so that we may meet the steadily increasing demand for fish suitable for stocking our inland waters. The State Fish Culturist is of the opinion that a great improvement could be made in our law by placing the scientific name after the common name of each fish mentioned. He also thinks that the State would derive a great advantage from a careful examination of our inland waters for the purpose of determining definitely the varieties of fish life inhabiting each, the kinds of fish food present, and various other matters of importance to fish culturists, but doubtless he will advise you fully as to these ideas in his report which follows.

Very truly yours,

J. D. LAWRENCE,

Deputy Commissioner

ALBANY, *December* 31, 1906.

Report of the State Fish Culturist for the year 1906

Hon. J. S. WHIPPLE, *Forest, Fish and Game Commissioner:*

SIR.— The report herewith submitted relates chiefly to the practical work of the hatcheries. It includes accounts of repairs and improvements at all the fish cultural stations, supplemented by the statements of the foremen, remarks on the distribution of young fish, notes on many of the species of fish reared or met with in fish cultural operations, food of trout, growth of brook trout, diseases affecting the life and vitality of the fish, treatment of these various disorders, and courtesies received from many sources or extended to correspondents and collaborators. These subjects are so arranged as to facilitate reference by persons interested in the progress of the work.

The output of the hatcheries was greatly increased over the yield of former years and everything points to still further gains. In whitefish culture much difficulty was found in collecting a sufficient number of eggs, notwithstanding the active and long-continued planting of fry. The causes of this falling off are not known, but will be carefully investigated.

General conditions are more favorable than ever before, and the outlook for the future is bright.

Hatchery Repairs and Improvements

ADIRONDACK HATCHERY.

During the fiscal year 1906 many important repairs and a number of much-needed improvements have been made at the Adirondack station. The permanent buildings have been put in excellent order, and rearing races with a capacity for more than 1,000,000 fingerling trout have been

completed. The water supply from lake sources has been greatly changed for the better. The one great need of this station at present is some means of utilizing the generous quantity of spring water available near the residence. When this is properly introduced into the races and mingled with the lake water so as to effectually control the temperature and prevent those rapid fluctuations resulting in losses of young fish, the results of the work will be greatly increased and its value enhanced.

Lake water is proverbially subject to great fluctuations of temperature. Even spring water varies so greatly in flow as to involve the stations in unexpected mortality in seasons of drought. The Adirondack Hatchery has a splendid resource in its large spring, and this can be utilized only by pumping. The cost of pumping water, as demonstrated at the Constantia station, is comparatively small, and there is no reason why the splendid Adirondack station should not have recourse to this method of obtaining cold water which is so essential to successful work in dry, warm seasons.

Foreman Winchester has preserved from time to time, and forwarded to the office of the Commission, specimens of the water fauna of the hatchery grounds. This fauna includes a number of animals which are commonly regarded as injurious to fish life — such as Hydra, a fish louse, and a leech, forms which are believed to destroy eggs and fry in greater or less numbers. Mr. Winchester has made some recent observations on the Hydra, and has reached the conclusion that it does not kill the trout fry to any considerable extent, although it certainly destroys eggs by clinging to them and withdrawing more or less of the fluid contents. At a Colorado station of the United States a species of Hydra was observed to kill trout fry, and it may be that the species at Upper Saranac will eventually be classed among the fry destroyers. Mr. Winchester, however, has seen nothing so far to show that the fry are injured by that animal.

A gill parasite, commonly known as the fish louse, one of the degraded forms of the copepods, is very injurious in its effects upon trout and especially yearlings, two-year olds and older fish. Unfortunately this is one of the parasites which abound in all wild trout and salmon waters, and which appear to be one of nature's checks on over production. The common Adirondack species was introduced into hatchery waters at Caledonia,

and before its nature was discovered it caused heavy losses among the two-year old brook trout as well as fish of greater age.

The only means of checking this parasite, available at most of our stations, is the introduction of a surface-feeding fish which will consume the swimming larvæ of this crustacean. For this purpose it is believed that the fresh-water killy will be most suitable for trout waters, as it is a lover of cold, pure streams such as trout inhabit. Doubtless there are other native fishes which may become available, but this one is suggested because its distribution in the State is rather extended, its size is small, and it would not, therefore, interfere with the natural or artificial reproduction of trout. Furthermore, it would furnish suitable live food for the large fish. It is a prolific species and when once established at a station it is reasonable to expect that its introduction would prove wholly beneficial.

Fungus is another fish pest much dreaded by fish culturists everywhere. This can be controlled at the stations, and has been controlled at the Adirondack Hatchery, by means of salt freely used in the troughs and races. High summer temperatures and scant flow of water have caused difficulty at this station and elsewhere. The only remedy for this situation appears to be the pumping of spring water suggested above. This natural drawback to trout propagation is a very serious matter often resulting in the loss of tens of thousands of fry and fingerling fish. One of the essentials of a successful trout station is the presence of a bountiful supply of pure spring water obtainable by gravity, if possible.

Pleasant Valley Hatchery.

The Pleasant Valley station has suffered many serious vicissitudes during the past, and its work has been hampered to a greater extent than one would consider possible. The stream flowing through the hatchery grounds is so thoroughly impregnated with injurious bacilli, originating chiefly through sewage pollution, that it is no longer suitable either for hatchery purposes or for rearing ponds, and I earnestly recommend that it be employed no more except as a sewer to carry off the waste from the ponds and the hatchery.

During the year the spring formerly owned by Mrs. Church, and used

by the Commission for supplying a number of outdoor trout races, has been purchased at a small cost, and is now available for permanent use. Other springs in the hatchery grounds have been brought together and are now used for supplying trout rearing races and ponds. A large quantity of spring water which formerly was wasted in the hatchery creek has now been diverted into the rearing basins. It is thought that the hatchery and all the necessary races and ponds can be fully supplied with pure spring water, and that the chief difficulties which have prevented the development of the station have been removed.

The old ponds which are known to be full of disease-producing germs should be discarded or they may be treated with quicklime and by winter killing before introducing spring water as a new supply. In this way it is more than probable that we shall entirely eradicate the most troublesome source of mortality among the brown trout at the Pleasant Valley station. So fatal is this ulcer disease to the brown trout that the station lost nearly all of its brood fish before the ravages of the disease were checked. It is known that a rapid flow of fresh water will ameliorate conditions produced by the ulcer disease. Acting upon this knowledge, the brood brown trout were liberated in the creek, and many of them were restored to health and were captured during the fall of 1906, when the spawning season commenced. Some of these trout were, of necessity, kept in the old ponds from which they had previously been removed, and they immediately began to show evidence of the ulcer disease. Many of them died, and the remainder were released, as before.

The best account of the ulcer disease is that of Dr. Hofer in his Fisch Krankheiten, pages 4–9, from which certain extracts have been translated and sent to stations at which the same trouble has been observed. These notes are in the chapter on Diseases.

The repairs at Pleasant Valley station included new work on the hatchery floor and roof, the icehouse and other outbuildings, the walks, painting, and other customary station improvements. There is some doubt as to whether brook trout can be handled as effectively at Pleasant Valley as at some of the other trout establishments, but with the new and improved conditions, an effort will now be made to increase the efficiency of this station.

One great drawback is a deficiency in the natural food supply for trout. The fresh water shrimp (*Gammarus* sp.), shipped there from Caledonia, has not multiplied abundantly, but another attempt will be made to establish it in the hatchery waters, and if this can be done it will greatly increase and cheapen the food supply. A little later on it may be feasible to plant the buckeye shiner (*Notropis atherinoides*) from Oneida lake, a favorite bait fish for black bass, pike-perch and other game species, and one of the most beautiful of the minnows. This little minnow is semi-transparent, silvery, with small scales, and sufficiently hardy to endure great fluctuations of temperature. It loves cold water, and may prove to be perfectly adapted for use as a natural food for the various kinds of trout. Foreman Scriba has shipped 1,000 of these minnows to the Adirondack Hatchery and an equal number to the Delaware Hatchery by way of experiment. If it be found that this species will live at these stations, supplies will be sent to all the other trout stations which have sufficient pond areas to furnish spawning grounds for the fish.

The repairs at Pleasant Valley station were accomplished at an expense of only about $300, and it is believed that the advantages will many times repay the cost.

Chautauqua Hatchery.

This station now depends for its water supply chiefly upon an artesian well which furnishes sufficient water of suitable quality for the hatching of maskalonge, and it could be used for various species of trout and whitefish within its rather limited capacity. It can now hatch about 8,000,000 to 10,000,000 of maskalonge eggs in a season. In 1906 the number of fry furnished by the station was above 5,000,000 out of a total of 8,000,000 eggs. A little stream runs through the hatchery grounds, and it is well known that ponds located in this small creek are well suited for rearing maskalonge up to the stage at which the fish must be distributed in order to prevent wholesale losses through cannibalism. The maskalonge thrives better in the creek than it does in the cement ponds and in the wooden troughs of the hatchery.

Foreman Brown holds the fry until they are able to swim up, then he plants them, and he does so because it is imperative to prevent them from devouring one another. The Pennsylvania Commissioner had about

1,000 of the young maskalonge at Corry station, and in a short time only one fish was left to represent the experiment. All the others had become victims of the process of "addition, division and silence."

Foreman Brown discovered that the fry on trays thrive best when the shallow trough containing the trays is furnished at each end with wire cloth, allowing free circulation of water throughout the trough. He found also that the fry in the cement ponds outside of the hatchery suffered much loss through sunlight, and this will diminish by furnishing floating screens to shut out the rays.

One of the greatest needs of the Chautauqua station is a larger water supply, and this may be obtained either by purchasing property and sinking additional artesian wells or by pumping water from the lake. On some accounts the latter method would seem to promise better results, for at certain stages of the work the difference between the temperature of the lake water and that of the artesian water is sufficiently great to produce shock to the eggs when placed in the hatchery water. This difference, early in May, often amounts to 7 or 8 degrees. The maskalonge egg is very delicate, and when subject to such a change of temperature, it often hatches prematurely and produces week embryos. Water could be pumped from Chautauqua lake without great expense, and in such increased quantity as to bring the capacity of the hatchery to any desired point. The demand for maskalonge is constantly increasing; it has never been satisfactorily supplied, and it cannot be fully met without an ample supply of suitable water.

The efficiency of the station could be still further augmented by introducing more hatching troughs and jars. The work could be increased by fully one-third by making the necessary additions to the station equipment.

Caledonia Hatchery.

This great station has been much improved by the introduction of a cement floor which now furnishes a solid foundation supporting the great weight of the hatching troughs. Cement walks have been laid around the building along one side and one end; the lining of the icehouse has been renewed; the rearing ponds have been repaired; the main hatchery has been shingled, and necessary painting has been done. Foreman Redband

has also been authorized to move one of the small meat houses not needed for its old purposes to constitute an office room attached to the hatchery at one corner. He has been directed to build a water wheel to furnish power for grinding fish food, thus reducing expense and economizing time.

Caledonia station needs some radical improvements, and when these have been accomplished there is scarcely a doubt that its former usefulness will not only be restored but will be greatly enhanced. Certain dead waters along the edges of the creek must be overcome by means of cement walls and by drainage and filling. One of the dams at the upper end of the grounds ought to be removed or modified. It is a constant drag to the efficiency of the station. All corners along the stream now containing dead leaves and other refuse should be renovated, and the water should flow through a clean bed, and be received in the ponds in much better condition than it is at present. Measures must be taken to destroy the surplus vegetation, and especially the frog spittle, which constitutes a great nuisance and causes heavy losses of fish.

The waters of Spring creek seem to be now full of the crustacean parasite referred to under the heading of the Adirondack station. They are so badly infested that it is no longer possible to rear brook trout in the station ponds. Of course it is not feasible to drain off ponds and kill the parasites by means of quicklime, and even if this could be done, it would not help matters in the creek. The only probable relief from this parasite appears to be the introduction of the surface-feeding killy, previously named, and it is believed that this killy will live and reproduce in the creek.

The capacity of the small trout brook at Guthrie's is limited, and in warm, dry seasons it becomes still further decreased and often causes unexpected and serious losses of fry and fingerling fish. It is hoped that some day the main creek at the hatchery will be restored to its normal condition with respect to parasitism and become available for brook trout.

Cold Spring Harbor Hatchery.

A moderate amount of money was devoted to repairs to the barns, icehouse and hatching-room, for painting, and for sinking an artesian well. The last is regarded as the most important improvement made at the Cold

Spring Harbor station in recent years. On July 16, when at a depth of 81 feet, the well flowed about 50 gallons per minute. When six inches deeper it furnished about 200 gallons a minute, at a temperature of 50 degrees, and has remained constant at that maximum to the present time. The diameter of the well is six inches, and its construction cost $4.50 per foot.

The water was found to be excellent for fish transportation, and after it had been running into the ponds, the growth of fungus was stopped.

Cold Spring Harbor is more than a trout station. It is a very important establishment for the culture of marine animals, such as the smelt, cod, tom cod, weakfish, flatfish, and lobster. Through its operation the shores of Long Island have been thoroughly stocked with smelt and tom cod very greatly to the delight of the anglers, and with beneficial effect upon the supply of food fish. A few inexpensive changes which the Commissioner has authorized recently will permit an enormous increase of activity at Cold Spring Harbor, especially with regard to marine species like the cod, weakfish, flatfish, and lobster. Some of these species require special apparatus which would be maintained and operated. Already the station is credited with about 105,000,000 of marine fry annually, besides the other work based upon brook trout, rainbow trout, brown trout and other well-known game fishes. The introduction of an increased amount of spring water will enable Foreman Walters to use this water not only in the hatchery, but also in all the numerous ponds of the station, and the effect will be to eradicate some of the most troublesome diseases which have ever attacked brook trout and brown trout under cultivation. Some of the trout streams on the north shore of Long Island are polluted by sewage. One of the results of this pollution is a skin disease particularly fatal to brook and brown trout. Another pest is the ulcer disease, referred to in the account of fish diseases. So injurious have these disorders become at certain times that tens of thousands of large trout have been killed by them. At Cold Spring Harbor, thanks to the new supply of artesian water, the troubles have been practically overcome.

Oneida Hatchery.

Early in the year 1906, the Commissioner directed me to investigate the condition and needs of the Oneida station. As a result of this instruc-

tion some very important improvements have been made. The stripping house for pike perch was formerly supplied with water through two-inch pipes running a distance of 1,200 feet from a small dam on Frederick creek. In the extremely cold winters these pipes were often split, and much of the water to be conveyed was lost. It was difficult to secure sufficient water to keep the brood fish alive in the tanks at the stripping house. A boiler and pump were purchased to furnish a new water supply. This apparatus with the necessary accompaniment of boiler house, pipe, etc., was installed on Frederick creek near the stripping house at a cost of less than $400. With a less outlay than was involved in repairs to the old pipes, the new water supply was greatly increased, easily maintained and rendered the practical work of stripping fish easy of accomplishment and far more successful than ever before. As a result of this increase of facilities Foreman Scriba was able to furnish 75,000,000 of pike-perch fry for distribution, the greatest output in the history of the station.

There has always been at Constantia the danger of a breakdown in the water supply pipe to the hatchery from the pond on Frederick creek. Sticks and other foreign substances have occasionally reduced the flow of water to such an extent as to threaten the efficiency of the work. Because it is impossible to overhaul the pipes under the hatchery, the difficulty of maintaining the water supply was much increased. For this reason the boiler and pump were moved in the fall from the stripping house to the hatchery and installed in a little boiler house attached to the hatchery building, and also communicating with the coal house. The principal object in moving this plant was to prevent any possible destruction of eggs and fry in the hatchery through interruption of the water flow from the pond. Another very important aim was to heat the hatchery, which has never been properly done heretofore. It was not an uncommon thing in my experience to find sheets of ice on many parts of the hatchery floor at a little distance from the stoves used for heating. During the winter of 1906, even when the temperature has been as low as 20 degrees below zero, the hatching room has been comfortably warm in all portions, and this has been accomplished with no more expense for fuel than was involved when the stoves were in action.

Foreman Scriba was instructed to build ponds for the propagation of

black bass, and proceeded to do this in the course of the spring and summer. There are now two ponds available for this new work, and one of them contains a stock of brood fish besides some young bass. It is expected that bass will spawn in the spring of 1907, and that both ponds will be ready to furnish a quota of small fish for distribution. The full plan contemplates the construction of at least two additional ponds for bass in the vicinity of the hatchery, and it may also be extended by means of other ponds on the Southwell tract, recently obtained by condemnation.

The stripping house has been moved on to State property in the triangle between Frederick creek and Scriba creek, and will obtain its water supply from a low dam on Frederick creek through a six-inch tile conduit. The bass ponds at the hatchery will be supplied with water from the hatchery pond through a twenty-four-inch square wooden flume. This flume will provide enough water to operate the ponds, and a ten-inch pipe may be drawn off from the head box to supply the hatchery if this should become necessary.

It is to be hoped that the Constantia hatchery will at some time be moved from its present position to a location near the mouth of Scriba creek, and that the Commission will acquire for its work the mill property now belonging to Southwell. With this land and water supply the work at Constantia could be greatly extended, and it is desirable that it should be so increased whenever the property can be acquired. There is no better point in the State for the culture of black bass, pike perch, and other food and game species. The hatchery can also greatly increase its work with whitefish, and it could handle lake trout, brook trout and other valuable species.

Oneida lake includes among its fishes a very valuable bait minnow known as the buckeye shiner. At certain seasons of the year this minnow ascends the creeks at the station in enormous numbers. As this fish is one of the favorite baits for black bass and pike perch fishermen and is, besides, good for trout food, being semi-transparent with silvery sides and iridescent tints, and quite hardy when the water is cold, it is thought to be suitable for introduction to trout waters as a food for trout. Foreman Scriba, has therefore collected a moderate number of these minnows and has shipped them to the Adirondack and Delaware hatcheries for trial. If they prove satisfactory, this work will be extended so as to include all

SURF FISHING AT MONTAUK POINT.— HOOKING A STRIPED BASS

trout stations having suitable pond space for the natural reproduction of the buckeye shiner, and a very important problem in the rearing of trout will be solved.

In June, 1906, Foreman Scriba discovered some small eggs attached to the under surface of stones in Frederick creek. As they could not be identified in the form of eggs, he was requested to place them in one of the hatchery troughs for development. The eggs were readily hatched, and when the young fish were sent to the office of the Commission for identification, they were found to be the common "Johnny Darter," a very important food for the larger fishes.

Usually in May a small fish known as the trout-perch ascends Scriba creek and Frederick creek in immense schools for the purpose of spawning. This little fish is one of the most valuable kinds of food for pike perch and other large fishes of Oneida lake. A peculiarity about it in Scriba creek is the occurrence of an eye disease which destroys one eye and sometimes both eyes during the spring months. The cause of the disease has not yet been fully studied, although specimens of the affected fish were sent to the Bureau of Fisheries, Washington, D. C., where they have been examined by Mr. M. C. Marsh. In order to arrive at a solution of this strange phenomenon, it will be necessary to keep living specimens under observation at Constantia and when this has been done a singularly fatal fish disease will be more easily described. All that is available for publication at present is the brief preliminary notice from Mr. Marsh which will be found in the paragraph on trout perch.

Fulton Chain Hatchery.

A visit to the Fulton Chain Hatchery showed the brook trout and lake trout fry in excellent condition. The pressing need of the station is an improved water supply to provide for the rearing of brook trout and other species to suitable age for distribution. Provision has recently been made for important betterments including the purchase of land and water rights which will greatly increase the usefulness of the establishment. This hatchery is capable of doing very good work, and if the appropriation asked for is granted it will bring about a surprising change. The station should either be improved or abandoned.

Several hundred dollars were devoted to the painting of the hatchery and ice house, repairs to the hatchery roof and chimney, and other changes desired relate to the walks about the hatchery grounds, retaining walls along the river, and pond construction, permitting increase of capacity. This station is favorably situated for extensive work in the culture of frostfish — a small species of whitefish greatly prized by the public. In Eighth lake, particularly, there is a large race of frostfish from which Foreman Burke obtained 575,000 eggs during the last season. The average weight of the fish is about one and one-half to two pounds. The spawning time is later than in any other of the lakes of the Fulton Chain, occurring in the latter part of December.

The frostfish is valuable not only for human food, but also for feeding the large trout and other game fishes. An objection urged to this species, and to all the white fishes, is the fact that it does not take the hook and is caught only in nets. It is sometimes held that such fishes are unworthy of the attention of the fish culturists, but it should be remembered that the time is not far distant when the imperative demands of the people for food fish must be met, and it will undoubtedly become necessary to amend the laws so as to permit the capture of whitefishes by any available method. It is true that such permission may involve the occasional destruction of trout, but the same objection will apply to many other methods of capture now authorized by law. As the main object of fishery regulation is the greatest good to the greatest number, it goes without saying that some modifications must be made from time to time to meet the urgent needs and demands of the people.

Distribution of Young Fish.

For several reasons the planting of fish in the future should be begun and finished earlier than in 1906. There is good ground for the belief that most streams can be successfully stocked with fry, and it is not necessary to hold trout at the stations until they reach the age of fingerlings. After the fry have begun to feed at the hatcheries they are prepared to seek and find natural food in the waters to be stocked. The State of Michigan furnishes a good illustration of the results of planting brook trout and rainbow trout fry. Pennsylvania secures equally favorable conditions by following the same course. Examples might be multiplied indefinitely. Shad fry

established the shad in rivers of the Pacific coast, from California to Alaska, wherein no shad were known before. At the present time the fish are so abundant in California, Washington and Oregon that they can be bought in the markets for two or three cents a pound wholesale. Whitefish, lake trout, smelt, tom cod, flatfish, maskalonge, pike perch, striped bass and many other well-known fish are sucessfully liberated in the fry stage. The U. S. Bureau of Fisheries, in 1906, liberated 200 times as many fry as it did of fingerlings, yearlings and adults.

The expense of rearing trout, salmon, black bass and other species to the fingerling age is very great, and the risks of loss through parasites, diseases, drought, sudden rise of temperature, and seasonal fluctuations of the natural food supply are too serious to pass unchecked. The cost of fish food at trout rearing stations often averages as high as $1,000 per annum, and at some stations it is still higher. For reasons of economy, prudence and experimental knowledge, therefore, the State cannot do better than to follow its own early system of distribution and thereby save expense and loss while accomplishing its work of maintaining the fish supply.

Fish Distribution

SUMMARY FOR THE YEAR ENDING DECEMBER 31, 1906.

Brook trout, advanced fry	42,000	
" " fingerlings	1,507,140	
		1,549,140
Brown trout, advanced fry	760,000	
" " fingerlings	318,000	
		1,078,000
Lake trout, advanced fry	5,322,000	
" " fingerlings	1,426,680	
" " yearlings	25,008	
		6,773,688
Rainbow trout, fingerlings		355,900
Black spotted trout, fingerlings		8,172
Total trout distributed		9,764,900

Frostfish	1,500,000	
Lobster	2,040,000	
Maskalonge	4,983,300	
Pike perch	75,045,000	
Shad	400,000	
Smelt	72,501,060	
Tom Cod	30,700,000	
Whitefish	38,225,000	
Yellow perch	515,000	
		225,909,360
Total hatchery output		235,674,260
Saved from the canal	1,482	
State Fair exhibit	1,106	
From U. S. Commission	11,570,000	
		11,572,588
Total distribution		247,246,848

Record of Each Hatchery for the Year 1906.

Adirondack.

Brook trout fingerlings	710,000
Lake trout fry	525,000
Smelt, adult	60
Whitefish	5,200,000
Total	6,435,060

Caledonia.

Brook trout fingerlings	157,750
Brown trout fry	610,000
Brown trout fingerlings	222,000
Lake trout fry	2,700,000
Lake trout fingerlings	700,455
Rainbow trout fingerlings	264,900
Black spotted trout yearlings	3,172
Whitefish	14,000,000
Total	18,658,277

Catskill.

Not opened. No shad work on Hudson river possible.

Chautauqua.

Maskalonge	4,983,300

Cold Spring.

Brook trout fingerlings	313,750
Lake trout fry	725,000
Lake trout fingerlings	58,000
Black spotted trout fingerlings	5,000
Lobsters	2,040,000
Pike perch fry	20,000
Shad fry	400,000
Tom cod	30,700,000
smelt fry	72,500,000
Smelt, adult	1,000
Whitefish	25,000
Total	106,787,750

Delaware.

Brook trout fry	32,000
Brook trout fingerlings	97,000
Brown trout fingerlings	56,000
Total	185,000

Fulton Chain.

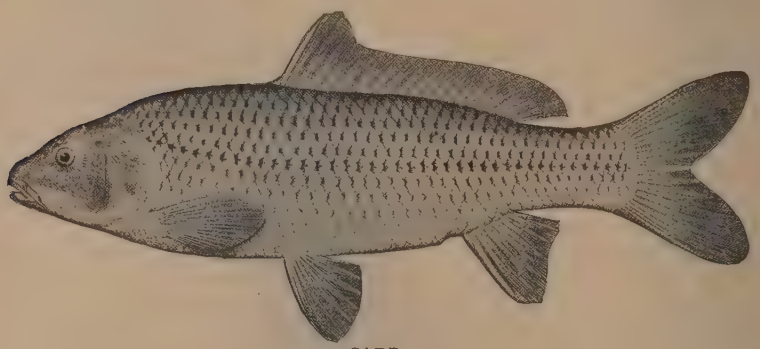
Brook trout fry	10,000
Brook trout fingerlings	95,750
Lake trout fry	872,000
Lake trout fingerlings	137,000
Whitefish	4,000,000
Frostfish	1,500,000
Total	6,614,750

Oneida.

Pike perch	75,025,000
Whitefish	15,000,000
Yellow perch fingerlings	515,000
Total	90,540,000

Pleasant Valley.

Brook trout fingerlings	132,890
Brown trout fry	150,000
Brown trout fingerlings	40,000
Lake trout fry	500,000
Lake trout fingerlings	531,225
Lake trout yearlings	25,008
Rainbow trout fingerlings	91,000
Total	1,470,223



CARP

Notes Upon Certain Fishes of New York

Carp.

While the Commission is sometimes asked for practical information about carp culture, its attention is more frequently drawn to injuries charged to this fish in lakes and rivers containing game fish. The carp is a big species, and it has a great appetite. Its food, no doubt, includes the eggs of more valuable fishes, and it certainly consists in large part of the seeds and bulbous roots of water plants, in the taking of which it deprives water fowl of their favorite sustenance and roils the water so as to make it disagreeable for fishes loving purity and cleanliness in their habitat.

In some lakes, such as Canandaigua and Chautauqua, it has become very abundant and extremely unpopular, and there is a steady demand for its extermination. Whenever a fish proves to be a nuisance and a menace to the existence of superior species with which it comes in con-

tact, the essential principles of fish culture require investigation into all the conditions reported and such treatment as may be found necessary and practicable. A scientific examination of these waters should be made by the Commission, and this should be followed by appropriate action based upon the facts established by the inquiry. Let it be understood at the outset, however, that the removal of the carp is not an easy problem.

The Buck Eye Shiner.

This is a local name on Oneida lake for the emerald minnow or rosy minnow (*Notropis atherinoides* Raf.) of the Great Lakes region, the Ohio Valley, and south to Tennessee. The fish has been collected in Six Mile creek below the falls near Ithaca, in a small stream near Montezuma drydock in company with the red fin, in Scioto creek at Coopersville, in the St. Lawrence river three miles below Ogdensburg, at Cape Vincent, and at Grenadier Island.

The buck eye abounds in lakes and in rapids of rivers. Mr. George F. Scriba and the fishermen of Constantia generally believe that it was introduced into Oneida lake many years ago. However that may be, it is now one of the characteristic fishes of Oneida, and has a high reputation as a bait for black bass and pike perch.

This beautiful little minnow is silvery, translucent, and its body is covered in life with iridescent hues, making it a choice morsel for the large game fishes. It ascends Scriba creek and Frederick creek, tributaries of Oneida lake at Constantia, in spring and fall in great schools. The spring migration may be for the purpose of spawning or for feeding upon the eggs and fry of the pike perch. In the fall it may enter the streams to find more open water than the lake affords.

The species is very hardy in cold water, but does not endure warm water in summer. It is the favorite bait of the angler and commercial fishermen and furnishes abundant and dainty food for the game species. If the experiment now in progress to establish it in trout waters proves successful, we may expect results highly beneficial to fish culture, as trout food is often costly and difficult to obtain in good condition.

At Constantia the buck eye was still in Scriba creek on May 10, 1906, and on November 9 of the same year it had begun to ascend, but not in large numbers. Foreman Scriba was expecting the big run before the creek froze up.

Shad.

The egg collecting season on the Delaware was very unsatisfactory and from the Hudson no eggs at all were obtained. Only about 400,000 fry were secured, and these were planted in Roeliff Jansen Kill, a large tributary of the Hudson near Linlithgo. An arrangement was made with the Pennsylvania Commission by which we were to pay $10 per million for good eggs, and we were to send our own spawn takers. Three men were detailed by Foreman Walters on April 17th for this work. Up to the 9th of May there were obtained in all only about 100,000 shad eggs from the Delaware.

At the new station to be established near Linlithgo, N. Y., it is intended to rear shad to the fingerling age and liberate them in the fall in the Roeliff Jansen Kill, from which stream they will make their way into the Hudson without obstruction. The site for this new station is at the junction of the Kleine Kill with the Roeliff Jansen Kill and embraces about twenty-five acres of ground abutting on the two streams mentioned. The Roeliff Jansen Kill is a beautiful stream containing, in its upper waters, many black bass. The creek has a sufficient fall so that by building a low dam water could be run by gravity through an old mill race on one of the tracts of ground obtained for the new station or, without damming the stream, water can readily be pumped into the race and the ponds which are to be constructed. The Kleine Kill is a small stream, but contains sufficient water at its lowest stage for considerable work. It has a series of falls aggregating about fifty feet in a distance of 400 yards and in such relation to the land as to make its conveyance by gravity effective and inexpensive.

The number of shad caught in the Hudson river in 1906 was too small to be worthy of consideration.

Smelt.

Remembering the successful work of George Ricardo in hatching smelt from the Hackensack river, New Jersey, information was sought from him

about the spawning of that fish in the Hackensack in 1906, but as it turned out, the Long Island streams furnished so large a supply of eggs, and kept the Cold Spring Harbor station so continually busy as to make it unnecessary to attempt collecting in the Hackensack.

An effort was made also to secure smelt and their eggs at Port Henry, on Lake Champlain, but this was unsuccessful owing to our lack of information about the particular spawning places and spawning times of the fish at Port Henry. A few adult fish were captured and were transported to the Adirondack hatchery by Foreman Winchester, and some of these were planted in a lake near the station. It is said that young smelt can be obtained near the shore at Port Henry at certain seasons of the year, and if this be true a second trial will be made in the hope of securing a large supply for stocking trout waters of the Adirondacks. The smelt is a fine food fish and is equally valuable as food for large trout.

It is easy to transport the smelt, as demonstrated by the experience of Commissioner Meehan, of Pennsylvania, whose men took 1,000 live adults from Cold Spring Harbor to Corry, Pa., a railway journey of eight and one-quarter hours, with a loss of only thirty-eight fish.

The smelt have been kept alive in fish cars three days. In some instances the fish would spawn in the cars, and the eggs would form in a bunch or ball as big as a cocoanut. These eggs were always found to be good: In collecting eggs at Great River or elsewhere, Foreman Walters proposed to put them on trays all matted up just as they came from the water and to fill the trays full. He advises that the eggs should not be left in the car or box long after the fish spawn. He fills the trough with fish, and if the fish are ready to spawn, and they generally are when they run up the creek, he leaves them in the trough about three days and then takes out the smelt and removes the eggs. If the eggs remain longer than three days in the trough it is very hard to separate them. The small eggs are very adhesive and bunch up into a mass. Mr. Walters rubs them through a screen and then places them in glass jars and gives them a good flow of water. If they bunch up again in the jars, he removes them, forces them again through the screen and then returns them to the jar.

At Cold Spring Harbor Mr. Walters finds strong light very injurious to the eggs, and he therefore places curtains at the windows to moderate the

light. In the New York Aquarium the light is rather dim, and is therefore just suitable for hatching smelt eggs.

The tide and moon, according to Mr. Walters, control the spawning of smelt. When the tide is about half up and the moon is about half grown, at seven or eight in the evening, smelt run up in goodly numbers, and they will arrive on the spawning grounds later and later every night after that. They ascend the streams until they find a good, clean gravel bed or coarse stones and lie there and spread their eggs all over the bottom.

Smelt eggs have not been carried out of water very long, but they have been shipped to the Bisby Club and the Sacandaga Club and reported good on arrival. They have been carried in cans of water from Brookhaven, a journey lasting eight hours.

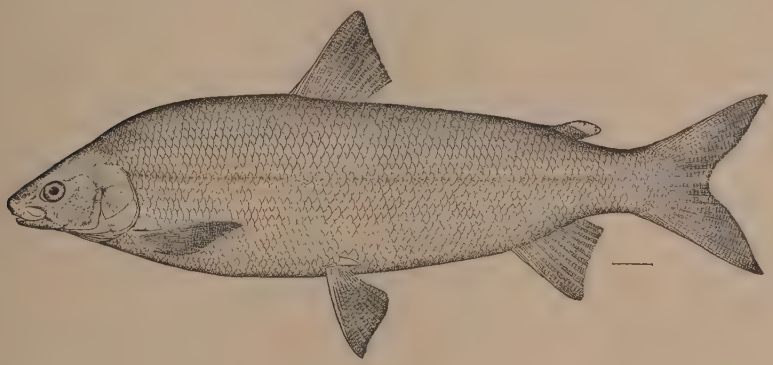
On March 10, at the small creek at Cold Spring Harbor, near the hatchery a few smelt were caught at night. At Great River the pool was seined every night and males chiefly were taken. It is believed that females for the most part were caught in gill nets at the river mouth. A few smelt were also taken on the night of March 10 at Huntington. Up to March 18 only about 7,000,000 eggs had been secured, and up to March 21 about 17,000,000 — Centerport having furnished the most of them. The fish were small in many cases, yielding only from 1,000 to 5,000 eggs. On March 22, Mr. Walters found the smelt spawning in the lower part of Jones creek, instead of at the head as usual, and the temperature of the water where they spawned was 42 degrees. On Great River, about the time for the smelt to spawn, they disappeared and could not be found, and gill net fishermen did not catch any after that date. On March 22, at night, about 1,500 to 1,600 very small smelt were picked up among the stones of Jones creek, at Cold Spring Harbor. They burrowed down among the stones to deposit their spawn. On March 29th, Mr. Walters had 37,000,000 eggs on the tables, a lot more in the troughs and another lot at Centerport. On April 1st Mr. Walters had about 60,000,000 eggs. He had some eggs that would count nearly 20,000 to the ounce — the smallest he ever saw. Centerport is the main locality for smelt eggs. On April 5th the collections amounted to 70,000,000 eggs. On April 8th, 10,000,000 more were taken from the bed of Jones creek at Cold Spring Harbor, and they were found to be perfectly good. Eighty-two million eggs had been collected up to

April 9th. At Cold Spring Harbor over 11,000,000 eggs hatched in one night.

WHITEFISH.

Notwithstanding the earnest efforts to collect eggs in the interior lakes in 1906, the yield was remarkably small. The entire number was 19,490,000, obtained from the following sources:

Big Clear lake	3,570,000
Lake Placid	4,704,000
Canandaigua lake	3,780,000
Lake Michigan (forwarded by Capt. S. M. Rose)	2,436,000



WHITEFISH

The United States Bureau of Fisheries furnished to the Commission 5,000,000 eyed eggs, which were received by the foreman, George F. Scriba, at Constantia, January 23, 1907.

Mr. R. R. Brown began preparations for whitefish work in Canandaigua lake October 29th. On December 5th the last eggs taken by him were received at the Constantia hatchery amounting to fifty-nine quarts, being 1,848,000 eggs. Mr. Brown had previously sent thirty-one quarts to the Caledonia hatchery. Thus the aggregate collection of eggs from that lake was ninety quarts or 3,780,000.

The work of taking eggs on Canandaigua lake was greatly hampered by bad weather, and more especially by the scarcity of ripe males. A record of the collections for several years past furnished by Mr. Brown shows a remarkable falling off in the take from year to year notwithstanding the annual planting of fry by the State. Whether or not there is an actual

scarcity of whitefish in the lake cannot be determined without examination of its waters. The spawning season is short and is very easily affected by the weather. It may be, therefore, that the yield of eggs is no safe guide to the abundance or scarcity of the fish. But the same falling off has been noted in other lakes which are constantly receiving deposits of fry. This renders it difficult to reach a satisfactory conclusion.

During the egg collecting season some question arose as to the disposition of the whitefish after they had served their purpose of furnishing eggs, and Mr. Brown was instructed to put back into the lake all the whitefish handled.

On Lake Placid the egg taking season began November 5th and closed November 19th. The work was in charge of Foreman George F. Scriba. Sixteen whitefish were caught in nets October 25th, but no ripe eggs were obtained. At the close of the spawning season, November 19th, the total collection of eggs numbered 4,704,000. The first eggs, amounting to three quarts, or 126,000, were taken November 5th.

There was a great scarcity of ripe males which resulted in the release, November 11th, of eighty-three females containing ripe eggs for lack of male fish.

In order to show the progress of the spawning period, it would be interesting to note the following dates when eggs were taken, also the number taken:

November 5	3 quarts
November 7 to 9	28 quarts
November 12	27 quarts
November 13	14 quarts
November 15	26 quarts
November 17	4 quarts
November 19	4 quarts

Again on November 11th, eighty-eight ripe females had to be released for want of males. Mr. Scriba thinks that the methods of netting whitefish are unsatisfactory, for the yield of eggs is falling off in spite of continual stocking. He believes that trap nets can be used to better advantage than pound nets in many cases. These nets also have the advantage of being

cheaper and easier to handle. In his judgment gill nets could be used more extensively than they now are. It is said that gill nets take more males, which are often hard to obtain when wanted.

In Big Clear lake one pound net was set on the night of October 15th. In Bone pond, October 15th, one ripe female whitefish was taken, which is two to six days earlier than the usual beginning of the spawning season. In Little Clear lake the fish began to spawn from November 1st to November 6th.

The accompanying tables showing falling off in the yield of eggs in Canandaigua, Big Clear and Little Clear lakes will be instructive in this connection. The number of eggs in a quart averages 42,000.

Mr. R. R. Brown sends the following figures concerning the egg collections in Canandaigua lake:

1897, 9 nets fishing	503 quarts
1898, 8 nets fishing	332½ quarts
1899, 6 nets fishing	157 quarts
1900, 5 nets fishing	74 quarts
1901, 7 nets fishing	220½ quarts
1902, 5 nets fishing	154 quarts
1903, 5 nets fishing	251½ quarts
1905, 4 nets fishing	169½ quarts
1906, 4 nets fishing	94 quarts

In 1904 no work was done at Canandaigua lake because the expense was greater than the yield warranted.

Foreman Winchester furnishes the following records of whitefish eggs taken in Big Clear and Little Clear lakes:

BIG CLEAR LAKE.

1902	42,000 eggs
1903	504,000 eggs
1904	2,667,000 eggs
1905	2,310,000 eggs
1906	462,000 eggs

LITTLE CLEAR LAKE.

1901	15,506,000 eggs
1902	13,818,000 eggs
1903	11,718,000 eggs
1904	6,384,000 eggs
1905	3,969,000 eggs
1906	3,908,000 eggs

FROSTFISH.

This is a New England name for one of the lesser whitefishes, which is also sometimes styled the round whitefish, menominee whitefish or chivey. It is an excellent food fish, attaining sometimes to the weight of two pounds. The Fulton Chain hatchery is in the vicinity of important frostfish lakes, and the eggs of the fish are secured from November to December. Foreman

FROSTFISH

Burke, of Old Forge, had varying success in various lakes of the Fulton Chain. Up to November 13th, First Lake furnished 400,000 eggs. Third and Fourth lakes, up to November 19th, gave poor results. On First lake three nights fishing were lost on account of ice. The lake froze over where the fish were spawning, and the men could not get to the grounds. Big Moose lake, which contains a very large race of frostfish, proved a good field. The eggs were taken there up to the end of December in fair numbers. In Third lake nearly all the fish taken were females, and not enough males were caught to fertilize the eggs.

LAKE TROUT.

The principal supply of lake trout eggs was obtained in October at Owen Sound, Lake Michigan. Thirteen hundred and sixty quarts were

brought to Caledonia November 1, 1906, by Foreman Redband. Owing to the stormy weather during the egg taking season and to transportation injuries the percentage of loss in these eggs was rather large, in some cases amounting to 50 per cent.

A change of policy in collecting lake trout eggs is advisable for the future. Instead of going a long distance for the supplies, it would be better to take the eggs at some point like Dunkirk, on Lake Erie, where the lake trout are known to spawn on Trout Shoal. From this point the eggs could easily be shipped as far as Caledonia without great risk of heavy loss.

On May 5, 1906, a carload containing 10,000 yearling lake trout was sent from Bath for planting. The cans were apparently in perfectly good

LAKE TROUT

condition and the fish seemed to be healthy, yet there was unusual and unaccountable mortality. According to the account of the messenger in charge, the affected fish came up to the top of the water, turned over on the side, and sank to the bottom dead. There were only 72 in each of the large cans. In some cases one half of the fish were taken out of the cans, but they died just as before.

The stocking of Lake Ronkonkoma and a lake near Southold, L. I., has been continued, but the results of the introduction up to date are unknown. Fingerling lake trout were shipped from Bath during the winter of 1905–6 to a lake at Southampton, L. I. It may be that some of the fish may be found in these waters, but thus far no results are reported.

Brook Trout.

Many of the losses at brook trout stations are caused by imperfect eggs. The hatching stations in New York no longer possess a large stock of brood fish, and most of the eggs developed are obtained from private stock. In some instances, the eggs are taken from young fish. In other cases injuries occur in transportation and disease attacks the egg because of some pollution of the packing material used in shipment. Moss frequently carries fungus spores which multiply in the egg trays and jars, causing the destruction of thousands of eggs and embryos. The well known white spot which is observed on the yolk sac of many recently hatched trout is supposed to be due to shock of some kind in egg transportation. There is room for very great improvement in apparatus for carrying fish eggs as well as in the methods of taking and fertilizing eggs. The use of young trout as egg producers should be discouraged, and greater care should be exercised in mingling the eggs and milt, as our experience shows a very large percentage of "ringers" from eggs recently held in some of the hatcheries. There should be no difficulty on this point, for it is customary to find an excess of males on almost any spawning grounds.

Among the causes of loss in brook trout is a species of fungus scarcely ever absent from trout waters. Fortunately this cause of disease generally yields to the salt treatment so well known to all fish culturists. Under the chapter descriptive of the State fish ponds at Caledonia reference has been made to a gill parasite of the brook trout, the fish louse introduced from Adirondack waters. So destructive is this parasite and so persistent when once introduced that it has rendered the holding of brood trout of this species practically impossible at Caledonia, at least in hatchery waters.

Singularly enough, the brown trout and rainbow trout are never affected and appear to be wholly immune from attacks of this copepod. On July 18, 1906, at Saranac Inn, brook trout fingerlings were dying from no apparent disease. Foreman Winchester stated that they commenced "whirling and boring in a circle, finally dropping to the bottom on the side, continuing this for some time until death resulted." The loss in one of the ponds most seriously affected was 250 fingerlings out of 20,000 to 25,000 fingerlings in twenty-four hours. This would seem to indicate a nervous disease

quite beyond the control of fish culturists. At Caledonia a few of the brook trout sent for examination show defective gills and imperfect tails — the latter resulting either from nibbling or from the attack of the fungus. It is noteworthy that this condition arose during a season of drought, and must have been due to insufficient water supply and overcrowding.

The losses in transportation were sometimes very serious. For example, in March, 1906, 50,000 fry were shipped from Saranac Inn to the Pleasant Valley station, and the mortality in transit was unusually heavy. These fry were in such a stage of development as to make their transfer rather difficult, and it is thought that the method of aerating the water en route, viz.: by the use of a dipper lifting a quantity of water above the surface and letting it fall through the air, may have been the principal cause of the losses.

Gill Parasite of Brook Trout.

Elsewhere in this report reference has been made to a crustacean which attacks the gills of brook trout at the State fish ponds at Caledonia, a species introduced there from Adirondack waters. In 1904 some specimens of the parasitized brook trout were sent to me from Caledonia, but as I am not a specialist on parasitic crustacea, the examples were forwarded to Prof. Chas. B. Wilson, Department of Biology, State Normal School, Westfield, Mass. Prof. Wilson very kindly identified the parasite, and the following extracts from his letter of March 11, 1904, will be interesting in connection therewith:

Westfield, Mass., *March* 11, 1904.

Mr. Tarleton H. Bean, *Chief Department of Fish and Game, Universal Exposition, St. Louis, Mo.:*

Dear Sir.— I find upon examination that the parasites on the gills are the form known as *Lernaeopoda salmonea* Linn. They seem to be fairly common in this country as well as across the water for I have had specimens sent me by the U. S. Fish Commission from the gills of trout in California, in Canada, and from Maine. The form is a very degenerate one, and after once attaching itself can never change its position. It does not seem to injure the fish unless its numbers increase beyond the ordinary. Sometimes in hatcheries or places where its natural enemies are removed or where the conditions are peculiarly favorable it will increase so fast as to prove a serious menace to the life of the fish.

So far no method has been found of getting rid of the adults, but the early stages can be disposed of easily by the introduction of top minnows, small sunfish, or other small fish that feed at or near the surface of the water where the parasitic larvae are swimming. These fish eat the larvae just as they do other small crustacea and so get back at them.

You will find a good description of the adults in Baird's " British Entomostraca," while the only thing published on the development is an article by Edouard van Beneden, entitled " Developpement des genres Anchorella, Lernaeopoda, Brachiella et Hessia," published in the Bulletin de l'Academie Royale de Belgique, (2), Vol. XXIX, p. 223. This latter article does not deal with the particular species in question, but with other closely allied species.

Rainbow Trout.

This introduced species appears to be growing in favor in many portions of New York. A very great difficulty in stocking streams with rainbow

RAINBOW TROUT

trout arose from its migratory habits. But in localities furnishing suitable conditions as to the size of the lake and other essentials it appears to give good satisfaction. Some years ago the South Side Sportsmen's Club of Long Island thought the rainbow unworthy of its attention and desired to get rid of its entire stock, but now the members have splendid fishing in the brackish water of Great river, and the trout run up into the stream to spawn in fresh water, usually beginning in January. Other Long Island clubs are restocking their waters with rainbow trout. One excellent reason for this return to the rainbow is its immunity from the ulcer disease which affects brown trout so seriously on Long Island and elsewhere.

It is practically useless to collect eggs from old stock fish. This has proved to be the case at three of the trout stations. The old fish yield

large quantities of shucks, and in some instances many of their eggs develop what is known as white sac.

In exchange for smelt from the Cold Spring Harbor station, Foreman Walters received some rainbows that were reared at the Bellefonte, Pa., hatchery. Some eggs of this fish are purchased in Michigan. Thus an attempt is made to introduce new blood and keep up a good supply of healthy fish.

Black Spotted Trout.

Five thousand eggs of this species were taken in Little Green pond at the Adirondack Hatchery, but all of the eggs which hatched died early. The successful introduction of this species into New York waters has not yet been accomplished. In many other localities it has been found extremely difficult to obtain good eggs from black spotted trout retained in ponds. A great drawback to the extensive distribution of this species is the late spawning period. The eggs are taken in May or June, they have a short incubation period, and on account of the high temperature of the water at the time of spawning, the ova are transported only with great difficulty.

Brown Trout.

The principal fatalities affecting this trout during 1906 were due to the well-known ulcer disease, to a failure to feed in the early stages of growth, and to acute inflammation of the gills and intestines caused by feeding upon hard and rough particles of food. At the Pleasant Valley station the greatest difficulty arose from the ulcer disease, already mentioned. This is thoroughly identified now as a disease due to pollution by sewage or other foul matter. It is difficult to realize the injurious effects of pollution by sewage in the trout waters of New York, and especially in the streams which receive closet waste from residences, public institutions and private establishments. In fact the work of fish culturists is so greatly impeded from these causes as to seem almost hopeless, and there is no reason why such pollution should be allowed to continue. It now causes the death and disappearance of trout and other important game and food fishes to such an extent as to render the future of fish cultural operations

uncertain, and, sometimes, unprofitable. Pollution of streams by factory and mill refuse is another fruitful cause of mortality among fishes. The formal reports of State and Federal Commissions and Bureaus are full of statements showing the deleterious effects of the introduction of acids, alkalies, sawdust, and other substances which destroy water life. There is no excuse for this state of affairs, as it is perfectly feasible to dispose of sewage and poisonous waste without allowing them to enter the streams. This is done in many foreign countries and in some parts of our own land, in fact such waste materials are often made a source of profit by conversion into fertilizers and other useful articles of commerce.

At Caledonia, the brown trout fry could not be induced, at one time, to feed upon liver, the only food generally in use at the station, and some mortality occurred through starvation. Believing that young fish would take crustacean food if properly prepared for them, Foreman Redband was advised to collect a lot of fresh water shrimp, grind them up minutely and offer the juices thus prepared to the fry in the troughs. This suggestion was carried out, and in a very short time the young began to take shrimp juice freely, the mortality was checked and the trouble was soon ended.

There has been considerable discussion of the policy of planting brown trout in State waters. The attitude of the present commissioner on this subject is unfavorable to the introduction of brown trout into waters which the brook trout now inhabits. He does not consider it desirable to liberate brown trout in such waters, because it is a much larger fish, growing far more rapidly than the brook trout, and soon driving away or destroying its smaller relative. It appears to be perfectly proper to stock with brown trout such waters as have become unsuitable and therefore no longer contain brook trout. There is room in State waters for both species, and each has its own advantages. Public sentiment will never abandon the brook trout which has long held a high place in the affection of the angler and nature lover.

Food for Trout.

This may be either natural food such as grows in trout waters, or it may be artificial or prepared food including liver and other animal substances

corn meal, middlings, etc. Among the natural foods will be found minnows, shells, fish eggs, crustaceans, worms, insect larvae, etc.

The main dependence at several of the trout stations is the liver of beef and sheep, and the lights, hearts, etc., of various domestic animals. Small fish either of the minnow family or of some marine family, like that containing the killies, are utilized to a considerable extent. The small eggs of certain fishes, especially herring, cod, and haddock, serve a very useful purpose. Sometimes the salted eggs of the haddock or herring are taken by the young fry in preference to all other forms of food.

Many difficulties have arisen in the early period of feeding of brook trout, brown trout and other species, and considerable losses have occurred from the failure to feed. Sometimes the brown trout can not be induced to take liver, but they feed readily upon the fresh water shrimp, which is one of the best natural foods of trout. Where salt water minnows like killies and silversides can be secured, they prove extremely valuable sources of supply. This is more especially observed at Cold Spring Harbor, Long Island; but minnows have been introduced, as stated above, at some of the other trout stations, and it is hoped that they will take the place of liver.

Whenever trout have access to ample quantities of natural food, and especially crustacean food and insect larvae, their growth is marvelously rapid. Illustrating this fact, the following paper by Dr. Samuel B. Ward, of Albany, will be found interesting and valuable:

Unusually Rapid Growth of Brook Trout.

Preliminary Note by Samuel B. Ward, M. D., and Erastus Corning.

In January, 1903, three gentlemen residing in the United States, rented from the Canadian government a preserve in the Laurentian mountains, about twelve miles west of the village of St. Urbain and forty miles from Murray Bay. Part of the agreement with the government was that we should employ and pay a guardian for the preserve, the appointment to be subject to the government's approval and his reports to be made to them. We employed a man who was born and brought up in the Lake St. John region, one-quarter Indian and three-quarters French, a man of mag-

nificent physique and thoroughly versed in woodcraft. He was instructed to go over the entire preserve and report what he found.

There are about twenty lakes in the preserve, from one-quarter of a mile to two miles long. There are no fish of any kind in any of the waters except brook trout. He reported one chain of three lakes in which there was not a single fish of any kind whatever, and accounted for this condition by the fact that in the outlet of the third lake there was a sheer fall of 100 feet, which it was, of course, impossible for any trout to ascend. His observation was confirmed by two of our own number who went to these lakes, examined them carefully and fished diligently, without being able to see a single trout. It was further confirmed by the statements of men who had previously fished this region for the market and who were thoroughly familiar with every lake on it.

Our guardian was, therefore, instructed to stock these lakes. During the autumn of 1903 and the spring of 1904 he caught in a lake about a quarter of a mile from one of these 750 small trout weighing from two to four ounces each, and placed them in the waters of one of these lakes, carrying them over carefully in a large, well-ventilated can. Every one of them was alive when placed in the water.

During the summer of 1904 these lakes were fished twice, for an hour or two each time, with no result whatever. During the summer of 1905 one of them was fished for an hour or so and two trout were taken, one of which weighed eleven ounces, and the other about six ounces, though it was not weighed. In the summer of 1906 extraordinary fishing was had. One day one party of three took out thirty-three brook trout that weighed sixty-six pounds and one ounce; and in another two days' fishing another party of three took out thirty-six fish that weighed sixty-six pounds and seven ounces. The largest one of the entire catch weighed a little over five pounds; several weighed over four pounds and a great many over three pounds. Many smaller ones were also taken out weighing from four or six ounces up to two pounds, showing that propagation of the species was going on.

As to the facts in the case there seems to be very little room for doubt. As to the catch in 1906 there is no doubt whatever. As to the fact that there were no fish of any kind in these waters in 1903 we have the statement

of an expert guardian whose observations on every point concerning the preserve have turned out to be very accurate indeed; and his observation was confirmed by two of our own number and by several perfectly disinterested witnesses. Had the growth of the fish not been so extraordinarily rapid, the question would never have arisen at all. It may be remarked in passing that all these fish were taken with flies, the Parmachene Belle and the Rube Wood being the favorites.

The trout were all of a rather peculiar shape, having a very large girth in proportion to their length — for instance, the five-pound trout measured only eighteen and three-quarter inches in length and fully fifteen inches in girth. All the others were in about the same proportion. They were all very fat, and on opening the largest ones nearly a handful of fat was found about the intestines.

We see no way of accounting for this extraordinary growth, except in the character and amount of food in these lakes. Of course, this has been collecting through untold centuries with no fish to eat it, and when the lakes were stocked there was a superabundance of food of all kinds. Having no microscope, the contents of the stomachs were not examined, and this deficiency we intend to remedy next summer.

We think that all observers are agreed that the efforts to stock the waters of the Adirondacks, and other regions, have been to a certain extent a failure. Millions of young trout have been placed in such waters, and only scores have reached maturity. If our theory about the growth of these fish is the correct one, it would seem that fish culturists would do well to try some method of increasing the food supply in lakes that are to be stocked. Among the Adirondack guides the theory is almost universal that there is no use trying to raise trout in waters that do not contain an abundance of chubs, minnows and fish of such species as constitute the food of trout. That this is a mistaken notion is plainly shown by observation of such waters as ours in Canada, in which no fish of any kind exist except speckled trout. Manifestly trout can and do thrive, and thrive well, on flies, crustacea and the like, in the entire absence of all food fish except the young of their own species. They undoubtedly are cannibals, for we occasionally find a small trout in the stomach of a large one; and yet the

large trout do not by any means destroy all the smaller ones; for in one of our lakes in an hour and one-half one afternoon one of our number caught seventy trout averaging about five ounces in weight, and it is an unusually bad day that one in the same length of time cannot catch thirty or forty.

It is a noticeable fact that our different ponds contain trout of very variable maximum size. In one of our ponds, about a mile in length, no one of our party last year took a trout weighing over eight ounces; in a second pond, only twelve minutes walk from this, several were taken that weighed about twelve ounces, and one that weighed over a pound; in a third pond, about two miles off, several were taken varying from three-quarters of a pound to one pound, and one of twenty ounces. The size of these lakes does not differ noticeably; the water is of about the same temperature; and it is difficult to attribute this difference in size of the fish to anything else than the character and amount of food.

In conclusion, we would urge upon those interested in fish culture the effort to increase the amount of food provided for trout rather than their artificial cultivation in hatcheries, and placing large numbers of small fry in the waters which are deficient in food supply.

At many trout stations a mush made of mill middlings mixed with liver has been found very acceptable for rainbow trout. Another very useful combination is known as Lane's food. It is prepared from the following recipe of the late George F. Lane, of Silver Lake, Mass.: Animal meal, 2 quarts; salt, 1½ pounds; corn meal, 8 quarts; mill middlings, 16 quarts; water brought to the boiling point, 24 quarts. These ingredients are thoroughly mixed and cooked in a large iron boiler and the compound is afterwards forced through a perforated cylinder in the shape of round, vermicelli-like strings, which are allowed to dry before feeding time. The strings are broken up into lengths of two and one-half to three inches and they are thrown to the trout in the ponds.

Haddock Roe.

This is to be obtained from salt fish dealers in Boston and Gloucester, Mass. Supplies were purchased from the John R. Neal Co., T wharf, Boston, for several stations, and answered a very useful purpose as long as they

could be kept sweet. The roe is not to be obtained during warm weather. The eggs are very small and, therefore, suitable in size for small fry, and they could be crushed into a sort of paste which floats readily on the surface of the water and proves attractive to the young fish. This has also been employed very effectively at the hatchery of the South Side Sportsmen's Club, near Oakdale, L. I. It forms a cheap and nutritious food for young fish.

Maskalonge.

The egg-taking season on Chautauqua lake began April 18, 1906, and on April 30th Foreman Brown reported that the fish were about done spawning below Bemus Point, but were nicely started up the lake. A snow storm in late April delayed the spawning. On May 7th Mr. Brown reported 7,000,000 eggs in the hatchery. On May 16th one jar of eggs commenced

MASKALONGE

to hatch. The shell of the egg was very dark — almost black. Premature hatching occurred in some cases, very likely on account of the difference in temperature between the lake water and the water of the artesian well, a difference amounting to seven or eight degrees. When eggs carried in the lake water were placed in the jars at the hatchery during such a difference of temperature many of them hatched prematurely.

At Bemus Point the eggs are brought to the hatching period in glass jars, but the embryo is too heavy to swim out of the jar, and it is therefore transferred to trays placed in running water in the hatchery troughs. The trays have wire cloth at each end to permit a rapid and uniform flow of water and to prevent the banking up of the fry at the lower end of the tray.

Mr. William Buller, of Corry, Pa., has hatched maskalonge eggs on the finest trout trays in water at a temperature of forty-five degrees. He

stated that the hatching period was sixty-two days, and that the fry obtained were fine and healthy.

The maskalonge kept in a small creek in the hatchery grounds at Bemus Point grew faster than those in the artesian water in the hatchery troughs and ponds. The artesian water apparently lacks something which the young fish require.

Maskalonge fry can be kept very easily until they begin to swim up, but after that period the losses through cannibalism are so serious that it has been found impossible to rear them either at Bemus Point or at Corry, to which latter station some of the eggs and fry from Bemus Point were shipped in exchange. On June 28th Foreman Brown was still holding 100,000 of the fry at Bemus Point. On May 30th 80,000 of the fry were taken to Corry, Pa., in two rather small cans. Shipment was successful, notwithstanding the crowded condition of the fry and the high temperature of the air.

CHAIN PICKEREL

Pickerel.

In some parts of New York the common chain pickerel is little esteemed, but in other portions of the State it is considered a fairly good fish and furnishes sport for the angler. A very fine race of pickerel, distinguished by its plump form and golden sides occurs in Otsego lake near Richfield Springs, from which place Mr. I. D. Peckham forwarded a beautiful specimen in the summer of 1906.

If the State should enter upon the culture of this pickerel, it would soon add largely to its distribution totals, because the eggs are abundant, easy to obtain, and are hatched with great facility.

Another kind of pickerel is especially plentiful in certain short tidal creeks of Long Island. This is the little banded pickerel, a fish seldom exceeding ten inches in length, with flaky, white flesh, very few bones, and with a delicious flavor. This pickerel is well worthy of the attention of fish culturists.

Striped Bass.

This valuable food and game fish has become very scarce in New York waters. If it spawns anywhere within the waters of the State no one appears to be able to tell where its spawning grounds are located. Many unsuccessful attempts have been made to obtain its eggs for artificial hatching. Even at Havre de Grace, Md., where a few eggs were secured

STRIPED BASS

some years ago by the United States Fish Commission, no attempt is now made to continue the effort because of repeated failures. The Bureau of Fisheries at present collects eggs of this bass in North Carolina. It is not difficult to hatch the eggs when obtained, but the supply, as compared with the number easily secured of other fishes, is very small.

In spite of the waning condition of the striped bass supply, market men are still selling immature bass in large numbers, some of them weighing only a few ounces. In California, where this bass was introduced from the Atlantic Coast, fish weighing less than three pounds cannot lawfully be sold. Under the present New York law, the lowest legal limit of length for a marketable bass is eight inches, but this is insufficient to protect the fish, and the law should be amended so as to make the lowest limit twelve inches.

If we do not take better care of the striped bass, we will have to obtain our supply from California before many years have passed.

Yellow Perch.

In the spring and summer the small yellow perch run up Scriba creek and Frederick creek from Oneida lake, at Constantia, in considerable numbers; but the greatest runs occur in the fall. On November 19th, for example, these creeks were full of small perch.

In spring and summer the perch are attacked by the same eye disease which is referred to under the remarks on trout perch, and a great many of

YELLOW PERCH

them are killed as a result of the disease. Those that lose only one eye frequently recover, but when both eyes are lost the fish becomes unable to seek its food, and it dies of starvation.

Pike Perch.

The common pike perch or wall-eyed pike is handled principally at the Constantia station, where from 60,000,000 to 75,000,000 of fry are developed annually. In 1906 the principal run of spawning fish in Scriba creek at Constantia lasted only about eight days, and the height of the season was from April 13th to April 17th, during which time 500 quarts of eggs were secured by Foreman Scriba. A common saying among the fishermen is that when the "peepers" are heard pike perch begin to spawn.

Blue Pike.

This is one of the small forms of the common pike perch, although it is usually distinguishable by its size and color. It spawns near Dunkirk later than the large form of pike perch living in Oneida lake and other New York waters, and its eggs have been artificially hatched in large numbers by some of the States. It is well worthy of more attention than it has thus far received.

Trout Perch.

This remarkable little fish combines the adipose dorsal fin of a trout with the spiny scales of a perch. It lives in Oneida lake and from there ascends Scriba creek, at Constantia, in great schools in the spring, to spawn.

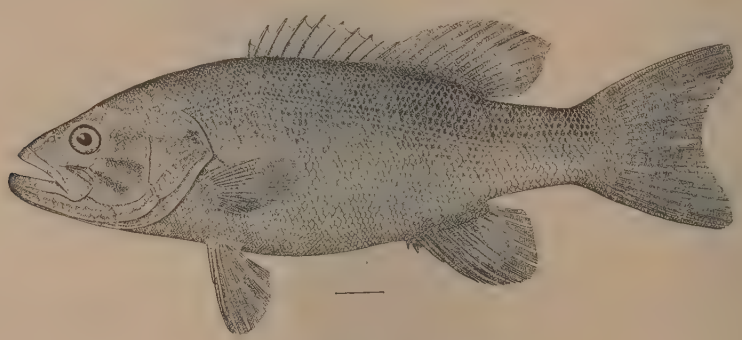
PIKE PERCH

This is one of the favorite foods of the pike perch, and, singularly enough, it is often mistaken for the young of that species.

Soon after the arrival of the trout perch in Scriba creek its eyes are affected by an unknown disease apparently of bacterial origin, and one eye or both eyes in numerous individuals are completely destroyed and removed from the skull. Desiring to learn something about this interesting and extremely fatal malady, which also affects young yellow perch, black bass, and several other species, some specimens were preserved in alcohol, glycerine and water and were submitted to the United States Bureau of Fisheries for examination. No satisfactory results could be obtained without study of living materials in the field, but Mr. Marsh, to whom the specimens were referred, recognized the nature of the disease and made some preliminary remarks upon it.

This disease was never observed in the creeks until four or five years ago. It lasts until freezing weather sets in and affects all kinds of small fish, but is never seen in large fish. Mr. Scriba has never noticed it in a pike perch exceeding five inches in length. The disease comes very suddenly and destroys the eyes in three or four days. The region in which this disorder appears seems to be limited in Scriba creek, from its mouth to the Southwell Mill dam. Frederick creek as far as the hatchery dam has it also, but in neither of the creeks does it occur above the dams, fish of all kinds in the upper waters being free of it.

Mr. Marsh wrote as follows on the subject: " I examined the eyes carefully but found no parasite save bacteria, which were not conclusive, as they should be present in such degenerations whatever the primary cause. The



SMALL-MOUTHED BLACK BASS

eyes contained considerable clotted blood * * * . The internal organs were much shrunken and some of the fish emaciated and there is probably a general infection, bacterial or protozoan, of which the eye disease is a part. We are much indebted to you for the specimens and for opening such an interesting subject and apparently a new one."

Black Bass.

The Commission receives from time to time specimens of fish containing parasites or affected by some disease causing disfigurement or death. From the office of the Forest and Stream Publishing Co. a small-mouthed black bass, caught in Culver lake, New Jersey, in June, 1905, was received for examination and report, and it was found that all of the viscera of this

bass were encased in a mass of cestodes forming a continuous sheath or membrane around certain of the organs, but without destroying the vitality of the fish. It was seen at a glance that the parasite represented the larva of a flat worm, but as the Commission has no helminthologist on its staff, the fish was forwarded to Prof. Edwin Linton, Washington and Jefferson College, Washington, Pa., the professor being recognized as one of the greatest living authorities on internal parasites of fishes. Prof. Linton identified the larva as a species of tapeworm (*Taenia* sp.). Since the receipt of the specimen referred to, other examples have been forwarded to the office of Forest and Stream for identification, and were found to contain the same parasite.

It is marvelous to note the extensive damage caused to the viscera of the bass by the mass of cestodes encircling them without apparently destroying the vigor and game qualities of the fish. The bass is probably only an intermediary host of this parasite. It is to be remembered that this particular species of tapeworm may never find in the alimentary tract of man its final resting place. The history of these worms is by no means worked out, and it is unnecessary to suffer alarm because of a probable injury which may never materialize. It may be that the final host of the tapeworm affecting the black bass is some species of water bird, and if so a practical deduction from the suggestion would be the desirability of keeping water birds off the lake at all seasons of the year. Whether or not this can be done remains to be determined by others. There is not the slightest doubt that water birds are not desirable tenants of trout lakes, and every trout culturist will use his utmost endeavors at least to frighten them away, if nothing more, because of the relation of the water birds to the final development of certain internal parasites.

Diseases

Numerous losses of fish under cultivation are due to diseases of various kinds, and especially to diseases of bacterial origin. If the injurious forms of low plant growth which infest the waters could be removed, the work of the fish culturist would be greatly simplified and extended. Such disorders as the ulcer disease of the brown trout, the skin disease of brook trout and

lake trout, maskalonge and other species, the red plague of the eel, and many similar serious affections would be unknown and millions of fishes would be added to the supply for distribution.

If to these causes of mortality be added the many organic diseases arising from a multitude of causes, and the disorders due to parasitic crustaceans, the wonder grows that the results of artificial breeding are not on the decline, but steadily increasing year after year. Some idea of the difficulties to be overcome may be gained from a glance at the admirable Handbook of Fish Diseases by Prof. Hofer, of Munich, a condensed account of the subject, but comprising 359 octavo pages, and showing a bewildering array of disorders among fishes, particularly those known in fish culture and the fisheries.

Translations of several of Dr. Hofer's articles were made and copies of them were sent to Foremen Walters and Davidson for their information. It is intended to translate all of the papers relating to the fishes of New York for the benefit primarily of our own foremen.

Furunculosis or Ulcer Disease.

The disease infects the brown trout and the American brook trout which have been cultivated in European hatcheries for some years, and it affects yearling fish as well as adults. Carp and other fish are not so susceptible to it; even among the Salmonidae, the rainbow trout up to this time has been immune from it.

The disease is most prevalent at spawning time — in the autumn months — although in many places it occurs the year around. The symptoms of the ulcer disease, according to the author's observations, are the following:

The first signs are most apparent in an extensive inflammation of the intestine and sometimes in the peritoneum. The entire middle and lower intestine will then appear very red and bloody — often so much so that death will ensue, although many of the fish survive the first stage. Sometimes the symptoms of enteritis are lacking, and the second stage manifests itself directly. In the scattered muscles, both in the deeper parts as well as in the superficial, hemorrhagic spots appear which are plainly distin-

tinguished by their color from the white muscle. These spots quickly develop into sores which break through the overlying flesh. Previously, however, the skin gradually bulges out so that swellings from the size of a pea to the size of a nut exist. The inside of this sore contains a bloody, watery mass of broken-down muscle tissues, ulcers and numberless bacteria. After the perforation of the sores flat ulcers of different sizes appear, most of them not larger than a five-cent piece. The sores extend deep, and from the open sores fistulas lead into the muscles from which at times a foul colored, bloody mucus flows. In most of the affected fish the bottom of the sore is covered over only with a small quantity of pus, which is continually washed away through the water by the movements of the fish.

In the circle of the ulcers not yet broken out appear distended ecchymoses which are seen here and there on the skin of the body and the gills. When the ulcers appear the fish, in from eight to fourteen days, become very sluggish in their movements. They separate themselves from their comrades, locate on the edges of the pond and are easily caught by hand. Frequently they show, at various places on the body, epithelium spots — gray spots — on which fungus growths very soon appear proceeding from Saprolegnia or Achlya.

According to the studies of Semmerich and Weibel as to the causes of the ulcer disease it originates with infection by Bacteria salmonicida, which as it shows itself from the intestine outward, as far as possible penetrates even the skin of the body and attacks every organ. It is seen very easily in the blood and also in the kidney, liver, and muscles.

These statements of Semmerich and Weibel have been confirmed by the author in many experiments in different places. At the beginning of the disease the author has repeatedly discovered that it is most likely to occur where there is putrefaction on the bottom of the pond and in the water. The ulcer disease may appear in ponds which have swampy bottoms, or in which the water trickles over swampy earth. It may, therefore, be found in ponds which are connected with a sewer pipe or drainage from manure heaps. It appears most readily, however, when in the course of artificial feeding remains of food in excess foul the bottom.

The course of the disease is usually short. Death generally occurs from two to three weeks after infection. There is, however, a milder

sickness which the fish overcome in which the ulcers leave visible scars. The epidemic is especially severe where the aeration of the water is deficient. It may well be conceived that in such case the disease is most deeply fixed, and not only does it appear in such ponds, but it spreads from the diseased fish to the healthy ones and even from one pond it is carried through the water to another pond.

The greatest care is necessary in feeding the fish to avoid this disease. Foul remains of food must be carefully removed. Therefore the trout ponds must be covered only by a clean gravel or sand bottom and not by humus or mucky bottom. The bottom, of course, can be dried out and made sanitary by drainage.

The introduction of seeds in great quantity which is practiced by the fish breeders in carp ponds must be strictly avoided in trout waters. Infected ponds must be perfectly disinfected with quick lime, which should be used in such quantity as to make the entire water of the pond cloudy like milk. Through the corrosive action of the lime hydrate, which is to be left in the pond fourteen days, all the bacteria are killed. Drying out and winter freezing of the pond bottom and of the banks are also necessary, but they are not always effective.

Curing the ulcerated brown trout or brook trout is not usually possible. Diseased fish should be removed and destroyed by boiling. This is not absolutely necessary, but it is very advantageous. In the case of a mild form of the disease, it is possible to secure a recovery of the fish if they are placed in a rapid current of cold water in which, obviously, a spread of the infection is very difficult.

Translation from Dr. Hofer — pages 4 *et seq.*

The Spot Disease of the Brook Trout.

(*Hofer, Handbuch der Fischkrankheiten*, pp. 33–34).

In our fish culture establishments, especially at spawning time, the American brook trout, Salmo fontinalis, has suffered greatly from a peculiar disease which is so virulent that most of the fish sustain great damage, so much so that some fish culturists, solely because of repeated occurrences of this disease in their stock, have entirely given up the breeding of brook

trout. The disease bears the name "Spot Disease" because it appears on the skin of the brook trout in the form of irregular spots of different sizes which persist in one place until the epidermis is loosened and the true skin lies exposed to view. The spots are outwardly flat and have a dull gray appearance. Secondary fungus growths are very noticeable on these spots. At the same time the diseased brook trout shows a very intense inflammation of the great intestine so that on the slightest touch against the side of the belly the fish exudes a bloody, mattery mass from the intestine. This sometimes flows from the fish just as readily if it is lifted up by the head. The disease progresses very rapidly; the sick fish swim excitedly here and there, try to jump out of the water, and die after a few days.

Up to this time researches as to the cause of the spot disease have not furnished a conclusion. This much indeed is established, that in the spot disease we have to deal with a bacterial infection; meanwhile the specific causative bacillus has not yet been made known in clear cultures. For this reason it is impossible to establish the relation between the spot disease and the condition through which the disease giving bacillus originates and increases so that we can positively identify the bacillus like that of furunculosis. It is not impossible that in the case of the spot disease putrefactive processes in pond water furnish the basis for a most probable origin of the bacillus, perhaps in consequence of pollution through remains of food. Meanwhile, when the disease originating bacillus is found, we will acquire positive knowledge.

The Red Plague of the Carp Like Fishes.

(*Hofer, Handbuch der Fischkrankheiten*, pp. 12–15.)

There is a certain disease which attacks carp, tench and perhaps other fish of the carp family which is particularly bad in fish ponds and which is therefore often called "Pond Disease." This name is wrong only in so far that numerous other diseases also originate in ponds. The disease is not infrequently observed even in winter ponds. It is by no means limited and localized to one spot, but has already become established in widely separated parts of Germany, so that after close investigation of its distribution, it is regarded as one of the commonest diseases.

Outwardly the disease shows itself in a more or less intense redness of the skin on the belly and sides. In the scale carp, in most cases, it is scarcely noticeable, in others, especially in leather and mirror carp, it is evident at a glance. Not only does the whole underside of the fish appear suffused with blood, but the lower fins also show blood red. On account of these marks, the disease is called " The Red Plague."

The red color of the skin is produced by an abnormal enlargement and overfilling of the vessels of the skin, as well as by effusion of blood in the skin itself. The appearance of the skin, however, is not the only symptom of the disease. The gills, also, are sometimes more or less decayed — broken down by necrosis. They have become as the experts express it, blighted and fouled. Small hemorrhages, moreover, are to be seen on them. The intestine very often is badly inflamed and is then not only greatly reddened but sometimes contains a bloody, slimy exudation, and in many cases is entirely eaten with little sores for a distance of almost one-third of its own length. The heart, also, is rather seriously attacked; the pericardium is thickened and is partly or wholly grown together with the heart muscles.

The cause of the disease exists in an infection of the fish with *Bacteria cyprinicida* Plehn, which is found in all the organs and is especially bad in the blood and kidney.

The Red Plague is most virulent when fish are kept in water polluted with foul organic remains. These conditions are especially noticed in fish hatcheries where the bottom of the ponds is strewn with dirty remains — worn shreds of skin, scales, etc., often several inches deep, and where the fish are badly overcrowded. It spreads apparently from one fish to another so that the fish catch the disease giving bacteria through their crowded condition.

Fish of the carp family infected with the Red Plague which live through a week's duration of the infection are finally destroyed entirely by this disease. A most careful study of the infection shows that death occurs in from five to twenty days. The sick fish are languid, usually rise to the surface, float there aimlessly, sometimes lying on the side, and then, without any sign of suffering, gradually succumb.

To escape the Red Plague cleanliness is one of the most essential conditions. Fish culturists should so arrange their ponds that the dirty remains and shreds of skin may sink to the bottom through an open wooden screen

about eight inches high and be swept away. The ponds are generally arranged so that the best and clearest water runs off from above a pond overflow while the foul remains collect in a heap on the bottom.

As soon as symptoms of the Red Plague are noticed, it is necessary to separate the diseased fish from the others, because the sickness is very contagious. If this cannot instantly be done the affected fish must be transferred to clean, swiftly flowing water, by which means part of them can be cured.

The Scale Disease of the Whitefishes.

(*Lepidorthosis contagiosa*).

(*Hofer, Handbuch der Fischkrankheiten, pp.* 9–12).

The scale disease affects the whitefishes, the various species of Leuciscidae, such as Döbel (Aitel) *Squalius cephalus*, Hasel, (*Leuciscus vulgaris*), Nerfling (*Idus melanotis*), Plotzen (*Leuciscus rutilus*), Rotauge (*Scardinius erythrophthalmus*), besides the Brachsen (*Abramis brama*), Carp (*Cyprinus carpio*), and many others.

Up to the present time it is with certainty recognized in the Iser below Munich, in the Spree in the neighborhood of Berlin, in the Rhine in the region of Lundeburg, in Petersburg among fish that were kept in fountains and the disease also has been epidemic among carp in the Kleinhesseloher pond at Munich. Apparently the disease is very widespread, and becomes especially virulent where the water is badly polluted with putrefying organic substances. When this disease is more rarely observed in open waters it simply means that the diseased fish, which here especially lose their activity even being totally paralyzed to the end of the tail, are quickly devoured by predaceous fish and by fish-eating birds. In inclosed ponds the disease can be observed most readily. The market ponds of many fish dealers are the best places in which to discover fish with the scale disease.

The symptoms of the disease are as follows: On the body of the fish, sometimes for its whole length, more especially on the upper part of the caudal section, the affected scales are raised up so that the body of the fish gives the impression of being swollen or blown up. This raising up of the scales is caused by a clear watery exudation formed in the scale pockets

which the previously smooth overlying scales set up. Pressure with the fingers on the roughened scales will force out the contents of the scaly pouch in a jet.

At the same time scale defects appear, and at different points ecchymoses are found which are especially bad on the fins.

In the early stages of the disease the fish seem to suffer little from it. Later on their movements are less rapid, their respiration is quickened, they become constanly more feeble until the caudal end often seems entirely paralyzed and becomes immovable and the fish, lying on its back struggling for breath, dies after one day.

In section the skin of the belly is seen to be greatly reddened — occasional hemorrhagic spots appear in the kidney and liver. The belly cavity usually contains a bloody humor.

Cause of the Disease.

Dr. Marianne Plehn, of the Biological Experimental Station at Munich, attributes the disease to the crab pest bacillus (*Bacillus pestis Astaci*) which is found in the blood and in all the organs of the sick fish. A common infection is produced under which the fish succumb before the characteristic symptoms appear on the skin and especially the roughened scales. Under what special conditions this general infection with the forming of an exudation in the scale pockets develops is not yet clearly understood. The bacillus agrees fully in all morphological and physiological attributes with the crab pest bacterium. If crabs are injected with pure bacteria culture from fish, the characteristic symptoms of the crab pest will be produced. The only difference between the crab pest bacteria obtained from fish, and those which are usually found in crabs is that they first show a smaller degree of virulence which increases in degree, however, so that one repeatedly conveys the bacteria through the crab's body.

As to the origin of the scale disease, it has long been known that the infection proceeds from the skin outward. This is corroborated by the fact that the roughening of the scales usually begins on the places on which scale defects were already present — therefore the impossibility of infecting uninjured fish if placed in crab-bacteria infected water, while the infection

is easily carried to an injurious extent if one introduces fish which have injuries of the skin and scales.

The course of the disease is generally rather slow, lasting often three to four weeks before the scale pouches are distributed over the entire body, when the fully paralyzed fish survives only one day more. In most cases the infected fish go to the bottom during the disease, and only in rare cases will their transfer to clear flowing water heal them.

In order to prevent the scale disease it is necessary to guard carefully against all injuries to the skin and keep the fish in inclosures and ponds which have been most thoroughly purified. Diseased fish must be separated from the sound ones, and inclosures and ponds must be disinfected with quicklime.

The Red Plague of the Eel

(*Hofer, Handbuch der Fischkrankheiten, pp.* 15–19.)

EEL

An epidemic disease, sometimes of enormous extent, which may be called the Red Plague on account of the characteristic red spots present on the skin, occurs in the eel from time to time in different localities. This is especially observed in the Danish part of the Baltic nearly to Ruegen as well as in the rich eel breeding waters of the Commachio Valley, in Italy, and particularly during warm summers.

The epidemic has been well known in Commachio for some time. It was reported in 1718 by Gian Francesco Bonaveri; later by Spallanzani, who stated that during thirty-eight days from July 15, 1790, 79,200 pounds

of eels were destroyed by it in the ponds of Commachio. In 1825 the well known embryologist Coste writes about a great mortality among the eels. Still later, from 1850 to 1864 and again in 1867 similar reports came from Italian writers.

In 1892 Canestrini observed the Red Plague in the eel again in Commachio, and especially in Campo Mazzano. Sennebogen recognized the same disease in Venetian waters and on the Dalmatian coast in 1884, 1885 and 1889; also in Herzegovina in 1898–99.

The epidemic was very marked in Danish waters from Seeland to Ruegen in 1896, and reappeared in the same region in 1897.

Sometimes in Seeland waters many thousands of eels die especially when they are overcrowded in ponds. The latest information about this disease is from Inghilleri, based on the observations of Prof. Gosio, to the effect that the same thing appeared in 1901 in ponds at Orbetello, in the vicinity of Grossetto, on the coast of the Tyrrhenian Sea.

The essential external symptoms of the disease, according to the author's investigations, consist in an intense redness or elongate circumscribed ecchymoses of the side of the abdomen, also in an especially well defined ring-shaped redness around the vent, in an equally distinct redness of the fins, and in scattered patches of inflammation of the skin on the back and sides of the body. Of the internal organs the intestinal tract appears seriously affected, especially the dorsal stomach wall.

According to the observations of Sennebogen, who has often studied the Red Plague in living eels, the fins first become intensely reddened on the surface, then isolated body spots appear, particularly in the region of the liver — at first small, point like, cherry red, hemorrhagic spots which gradually enlarge and expand into large red spots. The dead eels soon putrefy and pollute the air. Sennebogen observes that even before the eels are quite dead the tail may be decomposed.

The progress of the Red Plague is extremely rapid. According to Sennebogen the disease develops very quickly, the afflicted animals come to the surface, attempt to leave the ponds, become very feeble, even in the course of two hours the tail especially becomes completely inflexible and paralyzed, and shortly afterward death intervenes. The disease attacks particularly the large female eels when they are about to spawn. It is

HALIBUT [HIPPOGLOSSUS HIPP

always present in the warmest part of summer, but never in winter; it occurs frequently in Italian fresh waters and in brackish water, but is more uncommon in the salt water.

The cause of this epidemic was first discovered by Canestrini in 1892. Canestrini found, especially in the liver of the diseased eel, a bacillus which he recognized as the cause and designated by the name *Bacillus anguillarum*.

The *Bacillus anguillarum*, according to Canestrini, is harmless to warm-blooded animals; for certain fishes (eels, sticklebacks, gold fish) and amphibians (frogs, salamanders) it is pathogenic and most deadly, above all for the eel, in which Canestrini, by injections of clear cultures in the stomach cavity could produce the most characteristic symptoms, that is, hemorrhagic skin spots, redness of the pectoral and anal fins, sometimes even sores on the skin of the belly, more rarely on the sides and back. The last appearance of eels affected by the Red Plague in the Baltic, which I was unable to observe, Canestrini describes likewise as characteristic of the infected eels in Commachio.

In opposition to Canestrini, however, the latest observer of the Red Plague, Inghilleri, insists that the bacillus of the Red Plague of the eels studied by him and discovered by Prof. Gosio in Orbetello has shown itself to be very pathogenic to warm-blooded animals as for example sea dolphins, rabbits and white rats, and it also has shown a difference from the bacillus of Canestrini, according to the researches of the present author.

Under these circumstances, in fact, it appears not yet settled whether both authors have had in mind one and the same bacillus. It is all the more doubtful as Sennebogen states that red spots appear on the skin of the eel during the heated term of the year, when the eel suffers and chokes in the ponds from lack of air, which causes it to attempt to escape from the inclosures and thereby injures the skin so seriously as to produce hemorrhages therein. Confusion with the genuine Red Plague may very well happen in such cases, and is all the more possible because where the eels are gradually dying from want of oxygen, and almost during their final agony, bacteria enter, for example, into the bodies from the intestines.

Although up to the present no bacteriological examination of eels affected by the Red Plague in the Baltic has been made and the *Bacillus anguillarum* of Canestrini is not positively determined, the identity of the

disease in the Baltic and in Italian waters is very probable because of the identical symptoms and the similar course of the disease. More thorough investigations on these points are, nevertheless, much desired.

As to the origin of the Red Plague nothing satisfactory has been made known for a long time. It is believed that in the Baltic the high temperature of the summer is very favorable to the spread of the disease and to the great mortality. Sennebogen makes the same statement in Italy.

For the prevention of the Red Plague, at least in ponds, their establishment, according to Canestrini, may be recommended in fresh water, in which the *Bacillus anguillarum* is said to develop very scantily. Sennebogen, on the other hand, disputes positively the checking action of fresh water, because he has seen the Red Plague reproduce itself even in pure fresh water.

Fungus.

It is uncertain whether or not fungus is a primary cause of fish disease, but it is a very disagreeable and injurious associate of certain diseases. At one station a kind of fungus appeared on the back fin, the body behind the back fin, and on the tail. When attacked, the affected regions turned white, and the fish died very quickly. The remedies applied were a plentiful flow of cold water, thinning out, and the free use of salt.

Copper Sulphate.

The excessive growth of certain water plants in ponds and streams devoted to fish breeding is sometimes a source of trouble and loss. In order to control this difficulty, blue vitriol has been used as an algicide, and sometimes the results have been satisfactory. Experiments with the vitriol have been conducted by the U. S. Bureau of Fisheries and the U. S. Department of Agriculture.

A practical problem arising in the use of such an irritant caustic is to ascertain the strength of a solution which will destroy the algæ and not injure the fish or fish food. Useful articles in this connection are those of Mr. M. C. Marsh, published in the Bulletin of the Fisheries Bureau, and in the Transactions of the American Fisheries Society for 1905, and Bulletins

No. 64 and 76 of the Department of Agriculture, describing the studies of Messrs. George T. Moore and Karl F. Kellerman.

It is recorded that a ratio of one part of blue vitriol, or copper sulphate, to one million parts of water will not injure black bass eggs or fry, but it has proved fatal to brook trout even in a weaker solution.

Courtesies

Plans of black bass stations have been furnished by the U. S. Fisheries Bureau for consultation in establishing a pond station at Constantia. The Commission is indebted to that bureau also for a set of blank forms used in its hatcheries, for 170,000 brook trout fry, reared at the Cape Vincent station, 5,000,000 eggs of pike perch from the same establishment, 4,250,000 lake trout eggs, forwarded from Northville, Mich., and 5,000,000 eyed whitefish eggs. From the New York Aquarium 8,000 lake trout fry were obtained in May, 1906, and were planted in Lake Ronkonkoma. Twenty-five thousand whitefish fry and pike perch were presented by the aquarium for State waters. The Southside Sportmen's Club, of Long Island, through its president, Mr. George P. Slade, offered to aid Foreman Walters in collecting smelt eggs at Great River. On account of repairs in progress in the river the customary spawning run of smelt did not enter, but every effort was made by the club employees to help our work.

The Commissioner of Fisheries of Pennsylvania, Mr. W. E. Meehan, was allotted 5,000,000 smelt eggs and 1,000 smelt from the Cold Spring Harbor Station in exchange for brook trout and rainbow trout. Late in the year, Commissioner Meehan was granted permission to collect the eggs of lake trout on Trout Reef, near Dunkirk, with a view to restocking Lake Erie.

An exchange was made with the Wyandanch Club, of Smithtown, L. I., of 6,000 rainbow trout fingerlings, reared at Caledonia, for an equal number of brook trout from the club's preserves. The brook trout thus secured were planted in streams on Long Island.

Oak Orchard Lake

A trip was made to Medina, N. Y., on September 21st to examine the waters of Oak Orchard lake and to report upon steps desirable for stocking that body of water.

Fish Cultural Books

Many letters are received by the Commission requesting information about books and papers on fish culture. In replying no attempt is made to furnish a catalogue of the voluminous literature on the subject, but attention is usually directed to the Manual of Fish Culture, published in 1900 by the U. S. Commission of Fish and Fisheries, Washington, D. C. (now styled the U. S. Bureau of Fisheries). This manual is now to be obtained chiefly through members of the U. S. Congress and Senate to whom most of the copies were assigned for distribution. Reference is given also to Livingston Stone's classical work "Domesticated Trout; How to Breed and Grow Them," to Fred Mather's "Modern Fish Culture," published by Forest & Stream Publishing Co., 346 Broadway, New York city, to Hugo Mulertt's "The Gold Fish and its Culture," published in Brooklyn, N. Y., and to "Fish Hatching and Fish Catching," by Robert B. Roosevelt and Seth Green.

One of the essential conditions of successful fish culture is a proper supply of pure water. It is becoming more difficult year by year to secure this requisite and a vigorous enforcement of existing laws, as well as the enactment of new and more stringent regulations, will be urgently demanded if the fish supply is to be maintained.

Clearer definitions of the names and terms employed in the fish law are greatly needed, in order to prevent unintentional as well as willful violations. An illustrated pamphlet or small book containing descriptions and figures of the important fishes of the State would prove a great aid in educating the people and explaining the laws. A thorough investigation of the animal and plant life of the waters is much needed as a basis for practical work. The lakes and rivers of many parts of our State are about as little known, so far as their fish life is concerned, as the interior waters of Alaska. From 1842 until 1903 no general account of New York fishes was published and the last report on the subject has no illustrations.

Very little attention has been given by either the Federal or State governments to the study of diseases and to an investigation of the habits and growth of fish. We seldom hear of the results of planting and little is known about the capacity of the waters to furnish suitable natural food. The men who are supposed to know most about the food and game fishes in a practical way often make remarkable mistakes in identifying what they see in the waters. I think no one will deny the need of a manual of practical information upon fish culture and fish protection.

Realizing the growing demand for wholesome food and rational enjoyment, such as are furnished by the fishing waters of New York, and conscious of many obstacles to be overcome, it is time to take all the steps necessary to promote and perpetuate the fishing. If suitable appropriations for fish culture are regularly made it will not be difficult for the State to sustain and advance its high record in fish culture. Every employee in this branch of the public service is willing and anxious to do his utmost to promote the cause to which he is devoting the best years of his life.

Respectfully submitted.

TARLETON H. BEAN,
State Fish Culturist.

Report of the Chief Game Protector for the year 1904

Hon. D. C. Middleton, *Forest, Fish and Game Commissioner:*

SIR.—I hereby submit a summary of the work done by the force of protectors during the fiscal year ending September 30, 1904. It shows the number of prosecutions and the recoveries therefrom, the number of days served in jail on body executions by persons where fines were imposed and no money consideration received, the number of persons acquitted, and the suspended sentences, etc. An accounting is also made of the number of licenses issued under chapter 580 for the taking of birds, their nests and eggs, for scientific purposes; the number of licenses issued for the taking of fish, and the fees received; also the approximate number of pounds of fish caught and the estimated value of the same, and the kinds and value of the illegal devices that were seized and destroyed while being used for the taking of fish.

In previous years it has seemed advisable to recommend new legislation, but on account of the many valuable amendments enacted by the Legislature of 1904, very little improvement remains to be made. As a rule, the more the game laws are tampered with, the more confusing do they become to the general public.

Collectors' Certificates

Prior to the act of May 3, 1904, certificates for the taking of birds, their nests and eggs for scientific purposes, were issued by any natural history society incorporated within the State, or by the Regents of the University. It became apparent that the law was being abused, and that instead of birds being taken for purely scientific purposes, they were being taken, in many instances, by taxidermists to be mounted for ornamental purposes and for

sale. The law was accordingly changed, and the authority to issue licenses was placed in the hands of the Forest, Fish and Game Commission. Since the passage of the act referred to, much care has been taken to determine just who every applicant is and what his business is, and under this close scrutiny but five licenses were granted during the five months in which the law has been in effect.

The Shooting Law

The act of April 24, 1903, which prohibits the shooting of wild fowl during the spring of the year, did not have any effect on spring shooting that year, as the bill did not become a law until within six days of the close of the season. But the effect which the law had on the taking of wild fowl during the spring of 1904 has been something marvelous. Not being disturbed on Long Island, as they were in former years, until the inland waters were free from ice, the ducks worked north gradually to their breeding grounds. Many pairs dropped out at various points through the State, where large broods of young were hatched, which helped the fall duck shooting materially throughout the interior of the State. So excellent have been the results, and so general is the satisfaction with the new conditions resulting from the working of this law, that too much cannot be said in its favor.

Chapter 291 of the Laws of 1903, which prohibits the sale of grouse and woodcock taken in this State, has worked wonders in the way of an increase in these birds, as was shown by the great numbers that survived during that fall and winter, and raised large broods during the past spring. Thus far this fall the sportsmen are claiming that they have not seen so many birds in years, and if this law is continued there is no danger of the partridge becoming exterminated.

Adirondack Deer

Much was said during the past winter about the mortality among the deer in the Adirondacks, and many people became alarmed at these rumors, although they were advised that the deer had fared well, and that the few which had been found dead were found only within a small area on the southwest slope of the Adirondacks, mostly in the Moose river country. In fact,

the deer did not die in any such large numbers as was represented, and the mortality was only what might be naturally expected where the deer had become so plentiful, and had congregated in such large yards that they were pressed for food when the snow became too deep to break outside of the yards. When spring opened, the deer were seen in large numbers in their accustomed places, and thus far this fall there is every indication that they are plenty, and in many localities more numerous than in past years. However, while the deer in the Adirondacks are holding their own better than might naturally be expected, there seems to be a growing need for setting aside tracts of land as game refuges, especially as very many swamps and evergreen timbered sections are being almost denuded by lumbermen, which leaves the deer without cover or protection. It might be well, while purchasing land, to have this matter in mind as well as the purchasing of land to protect watersheds.

Commercial Fisheries

My attention has frequently been called, when issuing licenses to the net fishermen, to the serious falling off which has steadily continued in their business, and especially in the Hudson river fisheries. The season of 1904 was, as a rule, a poor one for the commercial fisherman, and these complaints continued, although the value of the receipts from the catch in Lake Erie and Lake Ontario showed a considerable gain. The figures in the tables representing the returns from these lakes are well worth studying by anyone interested in our commercial fisheries.

Attention was particularly drawn during the past season to the complaints of the Hudson river fishermen, whose business continued to show a marked decline. The returns for the season, when compared with those of 1903, showed a loss of fully 50 per cent, and a comparison of the number of nets used indicates that many fishermen did not continue their business. As will be seen by the statistical tables, the herring fishery fell off nearly 50 per cent as compared with the previous season, while the important shad fishery was nearly two-thirds less. There was also a marked loss in the sturgeon fishery which was once a highly important and lucrative business.

If the decrease of shad in the Hudson river is due to the water being

more polluted from year to year, on account of the growth of cities and towns along its banks, to such an extent that the shad fry planted by the State and the United States government, which should keep up the supply better than statistics show, and if the young shad would live and thrive after a short lapse of time if cared for in other waters, no better investment could be made than to erect rearing ponds on the small tributaries to the river, where the fry could be retained until of sufficient size and strength to stand the condition of the water or guard themselves from other species of fish that prey upon them.

It appears from the returns that the fishermen are giving much more attention to catching carp, and that the size and value of this species of fish are both increasing. I am informed that there is a good market for carp, and that considerable money is now being made in taking this fish from the river for the New York market.

Less Law Breaking

It is gratifying to note, by referring to the commercial fisheries, that there was a decided decrease in the number of violations of the law, and that not nearly as many nets and other devices were seized by the protectors during the year. It is my belief that this gratifying showing is due quite as much to a better understanding of the law, and an appreciation of its value by the fishermen, as it is to the continued vigilance of the force of protectors. The fishermen are in the main willing to uphold the law when they understand it, and learn that their own interests will suffer if they do not do so.

Collection of Statistics

In view of the situation indicated by the statistics collected for the past season, it is very desirable that better information be procured as to the conditions prevailing, and especially as to the Hudson river fisheries. This can only be done by employing some competent man steadily to collect the statistics and necessary information upon which to base some plan for the improvement of existing conditions. The Commission has each year planted large numbers of shad fry in the Hudson river, and the United

States Commission has planted even more. The steady falling off in this highly important branch of the fishing industry makes it necessary, however, to do something further, and plans are already being considered, in the hope of producing an improvement.

License Fees

As the State receives little or nothing from license fees for the use of nets, and as fish belong to the general public, and as the fishermen profit by the taking of an article in which they have no special property rights, they ought in reason to pay something toward the support of the State government. Therefore, the rules relative to the issuing of licenses should, in my judgment, be amended so as to charge a license fee according to the size of the nets, or so much per boat according to its tonnage.

From the foregoing remarks it will be seen that the Department of Game Protection has been fully as busy as usual during the past year and that the results secured have been fully up to the average. The outlook is for even better results in the future.

Respectfully submitted.

J. Warren Pond,

Chief Game Protector.

Report of the Chief Game Protector for the year 1905

Hon. J. S. Whipple, *Forest, Fish and Game Commissioner:*

SIR.—The protectors have been unusually busy during the past year, and the statistics of prosecutions under the Forest, Fish and Game Law, show that there were more than two hundred and fifty violations discovered and brought to a final accounting than in the preceding year. The total recovery amounts to $55,520.40 as against $18,134.42 during the year ending September 30, 1904.

Protection of Fish

The protectors have been very vigilant in the seizure of devices for the illegal taking of fish, and they have seized and destroyed about one hundred more nets than were taken the year before. This work is exceedingly hazardous, and the fish pirates are very bold, because one good haul will pay for a net, and everything taken in subsequent hauls is clear gain.

Illegal Devices Seized.

	BY REGULAR PROTECTORS.	BY SPECIAL PROTECTORS.	TOTAL.
Fykes	156	108	264
Traps	178	159	337
Gills	176	83	259
Squats	19	13	32
Seines	19	4	23
Set Lines	57	50	107

ILLEGAL DEVICES SEIZED — (*Continued*).

	BY REGULAR PROTECTORS.	BY SPECIAL PROTECTORS.	TOTAL.
Spears	4	2	6
Eel Weirs	3		3
Tip Ups	348		348
Dips	1		1
Fish houses	23		23
Haul nets	1		1
			1,404

Approximate value, seizures by regular protectors	$10,174 75
Approximate value, seizures by special protectors	6,727 80
Total approximate value	$16,902 55

About the same number of licensed nets were used in 1905 as during the preceding year, with about the same collection of fees. It has been deemed advisable for the next year to properly increase the amount required for a license, and as a result the State should receive from the new schedule of prices a revenue of about four times as much during the coming season.

During the year but thirty-four certificates for the taking of birds, their nests and eggs for scientific purposes have been issued. A great many applications have been received, and all have been denied but the above number. The coming year will find this number of certificates still further diminished because, from reliable sources, the Department has been informed that the birds of Eastern North America have been sufficiently studied for all practical purposes, and that these birds are of too much importance to the agricultural and horticultural interests of the State for this Commission to sanction their being taken indiscriminately.

Licensed Nets Used and Fees Paid.

WATERS.	FYKES.	SEINES.	GILLS.	TRAPS.	DROPS.	SCAPS.	POUNDS.	STURGEON.	FEES.
Hudson River	2,642	120	440	. . .	16	9	. . .	. . .	$810 00
Wappingers Creek	. . .	2	6						
Rondout Creek	4	1	9	. . .	. . .	1			
Delaware River	1	14							
Catskill Creek	. . .	. . .	. . .		2				
Ten Mile River	. . .	1							
Crumelbow Creek	. . .	1	. . .	. . .	. . .	. . .	. . .	. . .	1 00
Lake Erie	. . .	. . .	82	13	. . .	. . .	9	. . .	104 00
Lake Ontario	2	. . .	83	13	. . .	. . .	14	. . .	112 00
Seneca Lake	. . .	. . .	115	1	. . .	. . .	. . .	. . .	116 00
Cayuga Lake	167	. . .	. . .	. . .	. . .	. . .	. . .	. . .	167 00
Chaumont Bay, etc	293	1	26	89	. . .	. . .	. . .	7	416 00
Millsite Lake	. . .	. . .	6	. . .	. . .	. . .	. . .	. . .	6 00
Oneida River	. . .	4	. . .	. . .	. .	. . .	. . .	. . .	4 00
Total	3,109	144	767	116	18	10	23	7	$1,736 00

Minnow net licenses, 253	$253 00
Machine traps in Niagara River, 6	30 00
Certificates to collect birds, their nests and eggs for scientific purposes, 34	34 10
Total	$2,053 10

The reports of the fish taken in licensed nets and their approximate value as given by the fishermen for the year 1904 were incomplete, because the fishermen did not forward these reports promptly, and the additional tables will show what their returns are, also the final returns for the year. New plans are to be adopted this year under which our force of protectors will gather these reports and forward them to the Department. The average fisherman is lax in making his report, and while our rules and regulations prescribe that all tags must be returned and the reports of fish taken and value of the same shall be forwarded as soon as the licenses expire, he

invariably waits until he makes his application for a new license before he sends in his tag and makes his report.

The returns for the year 1905 have been much more satisfactory, because the fishermen have taken recognition of an urgent circular letter which was sent them, their reports were received within a reasonable time, and but very few are now outstanding. The returns show that, on the whole, fishing was not as good as the year previous. This is especially true of the shad and herring fishing in the Hudson river.

It should be remembered that the force of protectors numbers but 50, all told, and as the territory of each is very large it is impossible for them to apprehend all the violations that are taking place. But with the valuable assistance which the various game clubs and many law-abiding citizens are giving to this Department, the protectors have been enabled to enforce the law much better in their several localities during the year.

The force of special game protectors is large, but the Department finds that only a very small percentage of the specials render valuable assistance. However that part of the force of special protectors which is active forms a valuable auxiliary and is entitled to the highest commendation.

Respectfully yours,

M. C. WORTS,

First Asst. Chief Protector.

Report of the Chief Game Protector for the year 1906

Hon. James S. Whipple, *Forest, Fish and Game Commissioner:*

SIR.—I have the honor to submit the following report for the year ending September 30, 1906. Assistant Chief Protector M. C. Worts has covered the work performed by the protectors in the bringing of actions, the amount of recovery of fines and penalties and prison sentences of game law violators, the number and value of illegal nets and other devices for the taking of fish seized and destroyed, together with a summary of the licensed nets operated by commercial fishermen, with the fees received and the statistics of fish caught during the year, and other matters of interest connected with the enforcement of the Forest, Fish and Game Law of the State.

Mr. Worts has called attention to the decrease in penalties recovered for trespass on State lands, which in connection with the considerable increase in penalties recovered for violations would indicate that the vigorous prosecution of timber thieves by the department has had its effect. The increase of 35 per cent. over the previous year in the total number of actions brought, and the 100 per cent. increase in the amount recovered in fines in actions for fish and game law violations are the true index of the work accomplished by the Department. While the total recovery of fines, inclusive of forest trespass, as stated, is less than last year, it is more than three times larger than the recoveries for the year ending September 30, 1904, when the total amount was $18,134.42.

In the effort to secure more effective protection of fish and game it has been deemed advisable along with the regular enforcement to concentrate on one section at a time, and some of the worst territories for violations have received vigorous shake-ups during the past year. An

instance in point is the work done last summer in the lower New York bay. Through the courtesy of Police Commissioner Theodore Bingham, of New York city, police patrol boat No. 4 was put at the disposal of the Department, in a week's time a number of arrests were made and an effective stop put to the incursions of menhadden fishermen, who had been netting fish in New York waters.

The winter killing of deer for supplying lumber camps with meat has become a thing of the past as far as any wholesale violation is concerned. Some irresponsible jobbers undoubtedly still encourage the practice in a small way, but the larger camps are very careful to comply with the law, and in a number of instances the men are not permitted to have guns in camp during the close season. Throughout the winter months these camps are frequently visited by the protectors in whose territory they are situated.

The summer killing of deer, while at present a much more difficult matter to control, is confined to sporadic instances, and is not a serious menace to the supply. Successful violation of the hounding law is much less common than formerly, and will soon cease to figure to any considerable extent, as the danger of detection has increased, and there is also a growing local sentiment in favor of the law. The Department has taken in hand the matter of the removal of all hounds from the limits of the Adirondack park.

While deer have undoubtedly increased in numbers in many localities owing to better protection afforded during the close season, there are other localities where there has been no such increase. It is significant that these latter points are chiefly in the heart of the deer country. The ratio between the numbers of the hunters and the deer is constantly changing at the expense of the deer. Though the open season of 1906 was a month shorter than in 1905, more deer were killed by almost 10 per cent., judging from the record of shipments. There were more deer shipped in 1906 than in any year since the commission has kept a record of shipments and 40 per cent. more in 1906 than in 1904.

The increase in the number of hunters was very noticeable at the railroad stations in the deer country last fall. By far the larger number went into the woods in November, and it is common report in many

localities that more deer were killed in the fifteen days of open season in November than in the balance of the hunting season, the month of October. These facts make advisable the cutting out of the November hunting.

The winters of 1905–1906 and of 1906–1907 have been unusually favorable for the deer, and out of hundreds of deer seen in this time I have only found one which had certainly been winter killed. The favorable result is due to the light snow fall, which permitted the deer to travel far in search of food. During this time the heaviest cut of evergreen timber in the history of the Adirondacks has been made. Many famous yarding grounds for deer have been obliterated. The result will be that many deer will perish the first severe winter of heavy snows.

There is and always will be summer feed greatly in excess of the requirement, but even in an untouched forest the winter feed is rarely sufficient where deer yard thickly. The deer cannot find sufficient winter sustenance in a hardwood forest with the evergreens removed; nor can they get about in such country in deep snows, and every hunter knows that, deprived of the balsam and evergreen forest, they will perish. I do not think it an overstatement to say that the future of the deer supply in the Adirondacks depends more upon State ownership of the lands within the Adirondack park than on any other immediate factor.

The Missisquoi bay anti-netting agreement has turned out unfortunately again this year, as Quebec, contrary to the general understanding, has issued licenses to the commercial fishermen. Vermont has passed uniform laws with New York, and both States are mutually interested in putting a stop to netting in Lake Champlain. Quebec, by reason of its ownership of most of Missisquoi bay, which, while only a small fraction of the area of Lake Champlain is the only important spawning ground for pike-perch in the lake, is effectually interfering with this laudable object. These fish are taken up to April fifteenth, while on their way to the spawning beds, with the natural result that their numbers are steadily decreasing, as may be shown both by the testimony of the anglers and the records of the commercial fishermen. Added emphasis to Quebec's unfriendly attitude is given by the fact that the United States Government has for a number of years past maintained a fish hatchery on

the Missisquoi river, and has released millions of pike-perch in Lake Champlain.*

As a measure for the protection of our fishing interests I would recommend that section 47 of the Forest, Fish and Game Law be amended by striking out all that part after the first three lines of the section, which would have the effect of keeping pike taken outside the State out of our markets during the close season for pike, and would very materially strengthen section 47a, relative to the transportation of fish from the Province of Quebec.

Another section which imperatively requires amendment is section 52, relative to polluting streams. The last eight words of this section should be stricken out.

JOHN B. BURNHAM,
Chief Protector.

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* This hatchery was first started by the State of Vermont at Swanton in 1901, but has been operated by the Federal Government since 1903. Fish and Game Commissioner H. G. Thomas of Vermont is authority for the statement that in the first four years of its operation 80,000,000 pike-perch were planted. The new government hatchery on the Missisquoi river has a much larger capacity than the old hatchery.

Adirondack Game Report for the year 1904

HON. D. C. MIDDLETON, *Forest, Fish and Game Commissioner:*

SIR.—In presenting the compilation showing the condition of the more important wild animals of the woods, it is a satisfaction to note again the fact that, under the prevailing laws, there is a continuation of conditions satisfactory to the great mass of sportsmen. Recent evidence to this effect was given at the annual meeting of the Black River Fish and Game Protective Association, in December, when the Secretary, Mr. W. E. Wolcott, said in his report:

"Men who are familiar with the Adirondack region, and have had long experience in deer hunting agree that since jacking and hounding were abolished there has been a marked increase in the number of cervine animals; and that, notwithstanding the fact that the ranks of the hunters have been receiving large accessions annually, there are more deer in the woods now than there were twenty years ago."

There is, however, no question but that the hunters had a poor season in the Adirondacks as well as in the Maine woods in 1904. The leaves were late in falling, there was little rain or snow to wet them down or cover them after the trees and brush were bare, and, altogether, natural conditions did not favor good shooting. It is also a fact that many sportsmen were detained from their annual pastime by their interest in the political work of the campaign, and did not spend the usual number of days in the deer forest. Nevertheless the reports of shipments made from various Adirondack points by the American and National Express Companies show that the hunters had fairly good luck in spite of unusual disadvantages. The returns for the past five seasons are as follows:

The Annual Kill

YEAR.	CARCASSES.	SADDLES.	HEADS.
1900	1,020	89	95
1901	1,062	103	121
1902	1,354	113	193
1903	1,961	145	188
1904	1,618	124	152

From this table it appears that those who predicted that the aggregate number of deer killed during the past season would prove to be considerably smaller than the number killed during the open season for several years past were mistaken in their judgment. The figures show that the hunters procured a greater number of deer in 1904 than they did in any previous season except that of 1903 which showed an unusual increase, and which was noted at the time.

Attention is also called to the gratifying results of the investigation made by your order as to the mortality among the deer, the published reports of which were at one time so alarming. Undoubtedly a number of deer died in the Adirondacks and on Long Island last spring, from causes which were not generally understood; but it will be highly satisfactory to sportsmen to know that there was no general epidemic in the forest, and that there was no widespread destruction among the herds of deer. The investigation shows that these deaths occurred in well defined localities and from natural causes.

Appended will be found the reports of the autopsies performed on specimen deer brought down from the woods to the Bender Labratory in this city, and the highly interesting deductions drawn therefrom by Dr. Samuel B. Ward, who is as well known for his scientific attainments as he is for his familiarity with the Great Northern Forest.

A statement in detail of the shipments of deer from the Adirondacks is again made possible through the courtesy of Superintendent John L. Van Valkenburgh, of the American Express Company and Superintendent T. N. Smith, of the National Express Company, who have furnished the following figures from their books:

Shipments of Deer from Points in the Adirondack Region Season of 1904

Mohawk and Malone Railroad.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Beaver River	75	6	17
Big Moose	18	7	
Bog Lake	5		
Childwold	35	2	
Clear Water	34	1	
Forestport	26	1	2
Floodwood	15		
Fulton Chain	27	4	
Hinckley	2		1
Horseshoe	3		2
Lake Clear Junction	7		
Lake Kushaqua	4		
Lake Placid	1		2
Long Lake West	47	5	
Loon Lake	12	2	
McKeever	35	2	2
Middleville	2		
Minnehaha	4		
Mountain View	5		
Ne-ha-sa-ne	1		6
Otter Lake	4		
Paul Smith's	10	3	
Piercefield	65	4	3
Pleasant Lake	6		
Poland	26		1
Rainbow Lake	3		
Raquette Lake	42	6	
Saranac Inn	9	2	
Saranac Lake	14		
Tupper Lake Junction	54	8	1
White Lake Corners	8		
Woods Lake	8		
Total	607	53	37

NEW YORK AND OTTAWA RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Bay Pond	1		10
Brandon	5	2	
Childwold	11		
Derrick	47		
Dickinson Center	2		
Kildare	14	2	
Madawaska	23	4	1
Santa Clara	24		7
Sherman	19		
Spring Cove	28		
St. Regis Falls	12		5
Tupper Lake	14		13
Total	200	8	36

UTICA AND BLACK RIVER RAILROAD.

Alder Creek	10	2	
Benson Mines	45	2	
Boonville	7		
Carthage	3		
Castorland	8	1	
Glenfield	32		1
Harrisville	17	1	
Jayville	13		
Lowville	13	1	
Lyons Falls	10		
Natural Bridge	2		
Newton Falls	63		
Oswegatchie	12		
Port Leyden	8	2	
Prospect	31	1	
Remsen	5		
Wanakena	31	4	1
Total	310	14	2

ROME, WATERTOWN AND OGDENSBURG RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Canton	2		
DeKalb Junction	6		2
Edwards	8		
Evans Mills	1		
Gouverneur	2		
Norwood	1		
Philadelphia	1		
Potsdam	12	1	
Watertown	4		
Total	37	1	2

FONDA, JOHNSTOWN AND GLOVERSVILLE RAILROAD.

Gloversville	22	1	
Mayfield	1		
Northville	151	11	30
Total	174	12	30

LITTLE FALLS AND DOLGEVILLE RAILROAD.

Dolgeville	16		

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

Fonda	1		

RUTLAND RAILROAD.

Brushton	1		
Knapps			2
Malone	3		9
Winthrop	1		
Total	5		11

DELAWARE AND HUDSON RAILROAD.

Bloomingdale		1	1
Crown Point	3		1
Granville	1		

DELAWARE AND HUDSON RAILROAD (*Continued*).

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Hadley	3		3
Keeseville			1
Lake George	1		
Loon Lake	2		4
North Creek	152	33	2
Port Henry	21		3
Port Kent		2	1
Riverside	11		3
Saranac Lake	1		
Stony Creek	73		
Thurman			1
Ticonderoga			5
Warrensburgh			2
Westport			7
Total	268	36	34

RECAPITULATION.

Mohawk and Malone Railroad	607	53	37
New York and Ottawa Railroad	200	8	36
Utica and Black River Railroad	310	14	2
Rome, Watertown and Ogdensburg Railroad	37	1	2
Fonda, Johnstown and Gloversville Railroad	174	12	30
Little Falls and Dolgeville Railroad	16		
New York Central and Hudson River Railroad	1		
Rutland Railroad	5		11
Delaware and Hudson Railroad	268	36	34
Total shipments	1,618	124	152

As usual there were a number of large deer among those killed, and among the notable shipments were the following:

NOTABLE SHIPMENTS.

RAILROAD STATION.	CONSIGNEE.	DRESSED WEIGHT, POUNDS.
Gloversville	J. L. Merrill, Rochester	200
Northville	R. Brownell, Amsterdam	240
Northville	W. O. Bronson, Schenectady	252
Northville	M. Floyd, Amsterdam	221
Northville	R. S. Foster, Fonda	205
Santa Clara	Chas. Miller, New York	203
St. Regis Falls	M. Barnet, Potsdam	20
Newton Falls	J. Mansfelder, New York	201
Wanakena	D. Whiting, Syracuse	203
Edwards	M. Dowling, Gouverneur	226
Edwards	Jerome Warden, Albion	200
Edwards	H. J. Hurlburt, Gouverneur	200
Potsdam	R. E. Goodnough, Gouverneur	203
Fulton Chain	E. D. Parsons, Canandaigua	200
Fulton Chain	T. I. Isbester, Stockport	200
Piercefield	T. H. Parson, Saranac Lake	210
Saranac Lake	J. Brennan, New York	200
Tupper Lake Junction	T. M. Healey, Utica	250
Tupper Lake Junction	George Peck, Buffalo	200
Tupper Lake Junction	J. Jordan, Albany	205
Spring Cove	M. J. Bernhard, Buffalo	200
Sherman	Geo. Arno, Santa Clara	204
Sherman	S. Davis	225
Sherman	R. Schley, Dickinson Center	220
Lake Kushaqua	W. Donaldson, Lake Clear Junction	200
Wood Lake	R. Williams, Utica	210
North Creek	W. T. Haywood, Albany	215
Port Henry	L. Alexander, New York	217
Riverside	A. Shapiro, New York	220
Stony Creek	Elmer Barnes, Mechanicville	250

The newspapers of Essex county stated that Mr. Alexander's kill was an eleven-pronged buck, and was the heaviest of the season in that locality.

There were but few fatal shooting accidents reported.

Elk and Moose

Reports indicate that the number of wild elk in the Adirondacks has increased steadily since the first herd of twenty-two was liberated in June, 1901. The animals are so widely distributed through the Adirondack counties, and have so separated into small bands that it is no longer possible to state accurately their number. It is estimated, however, after making allowance for probable fatalities, that there are no less than 200 elk now in the woods. The animals appear to winter well, and the experiment of introducing elk into the woods is no doubt a success. During the last session of the Legislature an Act was passed giving the Commission authority to acquire live elk by gift as well as by purchase. As no appropriation is available, donations of elk to the State would prove highly acceptable, if only for the purpose of infusing new blood into the present herds.

Owing to the lack of an appropriation, it has not been possible to procure additional moose. The friends of the movement to restore this animal to the Adirondacks insist that not enough moose have been purchased and liberated to make the experiment a fair one. They point to the success which has attended the introduction of elk as an evidence of what might be done if a sufficient number of moose could be set at liberty.

The Black Bear

Sportsmen, headed by Mr. H. V. Radford, of New York, last winter secured the passage of an Act which gave the Black Bear legal recognition as a game animal for the first time in the history of the State. Under this law the bear is protected during the months of July, August and September, the time when its pelt is without value. The law also provides for the filing of a report with the Commission by each hunter killing a bear, so as to show the place and date and the sex and weight.

The reports received by the Commission from the time the law went into effect (May 9) to December 31, are shown in the following table:

COUNTY.	MALE.	FEMALE.	SEX NOT STATED.	SHOT.	TRAPPED.	METHOD OF TAKING NOT STATED.	TOTAL.
Cattaraugus	2	1	. . .	2	. . .	1	3
Clinton	1	4	. . .	4	. . .	1	5
Delaware	1	. . .	. . .	. . .	. . .	1	1
Essex	1	. . .	26	1	. . .	26	27
Franklin	1	. . .	. . .	. . .	. . .	1	1
Fulton	2	2	. . .	2	. . .	2	4
Greene	4	9	5	4	. . .	14	18
Hamilton	5	2	. . .	2	. . .	5	7
Herkimer	3	1	4	2	2	4	8
Lewis	3	. . .	. . .	1	. . .	2	3
St. Lawrence	3	2	1	. . .	1	5	6
Ulster	5	13	1	4	. . .	15	19
Warren	4	. . .	. . .	1	. . .	3	4
All counties	35	34	37	23	3	80	106

The greatest weight recorded was that of a male bear shot in Cattaraugus county by F. E. Morrison, of Tunesassa. It was 428 pounds. Four other bears reached or exceeded a weight of 400 pounds. Seven were given as weighing between 300 and 400 pounds; nineteen between 200 and 300 pounds, and twenty-eight from 100 to 200 pounds. Seventeen were recorded as weighing less than 100 pounds, three of which were cubs weighing but ten pounds apiece. The weights of thirty of the bears reported killed were not given.

It is not probable that the above records include the entire number of bears killed in the State during the time specified. The Hon. Charles C. Coutant, Member of Assembly from Ulster county, declares that fully fifty bears were taken in his county during 1904. If this be true more than one-half were not reported to the Commission. While the law enacted by the last Legislature providing for a close season on bruin requires that "Whosoever shall kill or take a black bear shall within sixty days file with the Forest,

Fish and Game Commission a record of the date such black bear was killed or taken, the place where killed or taken, together with the sex and approximate weight of said bear," through a technical mistake the penalty of $25 for failure to so report was dropped out when the act became effective, so that at present the Commission is unable to effectually enforce the requirement. It is presumed that the legislature of 1905 will supply the omission.

In Essex county where a bounty is paid on bears killed, the Hon. C. C. Whitney, county treasurer, reports that the total number of bounties paid during 1904 was 39.

Beaver and Otter

With the appropriation of $500 made by the last Legislature for the purchase of beaver, which Mr. Radford and other sportsmen hope to restore to the Adirondacks, the Commission has been able to purchase three pairs of these interesting animals and an additional male. The beaver were taken to Old Forge late in December, and ordered kept there at the State hatchery through the winter, as it was not deemed advisable to liberate them until Spring. The Adirondack guides are taking great interest in this experiment, and it is hoped that in time colonies of beaver will again be found in many parts of the forest.

The last Legislature also enacted a law forbidding the taking of any otter prior to October 1st, 1906. This action on behalf of a rare and valuable animal indicates the awakening interest of the people in the more important fur bearing animals of the State. To preserve, to perpetuate and to restore is every year becoming more and more the wise policy of the State as its citizens come more fully to understand and appreciate the important position which game and forest conservation hold toward the health, happiness and prosperity of the Commonwealth.

Following are the reports and the accompanying letters relative to the mortality among the deer in the Adirondacks.

Respectfully yours,

JOHN D. WHISH,

Secretary.

BENDER HYGIENIC LABORATORY,

ALBANY, N. Y., *April* 12, 1904.

Hon. DEWITT C. MIDDLETON, *New York State Forest, Fish and Game Commissioner, Albany, N. Y.:*

DEAR SIR.—I have the honor to submit, herewith, the report of an investigation which had for its object the determination of the recent unusual mortality among the Adirondack deer. The investigation was undertaken at the suggestion of Col. Wm. F. Fox, Superintendent State Forests, and with the co-operation of Dr. Samuel B. Ward. I have made my report in the form of a detailed description of the findings in each deer, and have appended a general summary.

I may add that no method of bacteriologic or pathologic investigation which might give information has been neglected. The report is as follows:

EXAMINATION OF DEER NO. 1.

Young male received at Bender Laboratory, March 9th at 11:30 A. M., in frozen condition. Autopsy begun at 12 M.

Superficial examination shows incisions in both fore legs just above fourth joint; apparently made after death. No other marks of external injury are visible. Inspection of hoofs, tongue, mouth, nares, negative.

The carcass is greatly emaciated, subcutaneous fat being entirely absent. Abdominal cavity contains very slight amount of clear fluid, which is of a slightly reddish color. This color is apparently due to a solution of the hæmaglobin of the blood, as the result of freezing. Peritoneal fat has entirely disappeared, the omentum and mesentery appearing as thin fat-free membranes.

Stomachs and Intestines.—Are greatly distended with partly digested material. The entire amount of material in all stomachs is eight and one-half pounds. This consists of partly digested light-greenish material, in the midst of which may be found fragments of evergreen twigs. This material is found in fair amount in the intestines. The large intestine found filled with well-formed fæces.

Heart.—Normal.

Lungs.—Show some congestion of the dependent portions, but otherwise normal. Left lung at apex shows slightly denser tissues than is found elsewhere.

Œsophagus and Trachea.—Normal.

Abdominal Cavity.—All organs of the abdomen are normal except the liver.

Liver.—Is greenish-brown in color, apparently enlarged and its surface uneven and marked by several large irregular swellings. On section are found five cavities, measuring 3 to 8 cm. in diameter and containing thick brownish fluid with foul odor. From these cavities were removed, in all, eighteen flukes (*Fasciola magna*). The walls of the cavities containing these parasites are thickened and greyish in color. The liver substance is bile, stained and of increased consistence. No flukes are found in the intestines or adjacent blood vessels.

The *brain* and its membranes are normal.

Bacteriology.—

Cultures from the peritoneum, pleural cavity, heart's blood, and spleen are sterile.

Cultures from nostrils show *staphylococcus aureus;* from liver, kidney and lung various saprophytic organisms, apparently the result of post-mortem infection and of no importance.

Histological Examination.—

Adrenal gland, heart muscle, muscles of limbs and trunk and kidney normal.

Lung.—Œdema. Firm nodule from apex is composed of dense fibrous tissue with evidence of old hemorrhage. No evidence of tuberculosis.

Spleen.—Extensive deposition of old blood pigment, apparently hæmosiderin.

Liver.—Irregular areas of fibroid induration with extensive pigmentation. Numerous fluke eggs in wall of fluke cavities.

Pathologic Diagnosis.—

Extreme emaciation.
Fluke disease of liver.
Chronic localized hepatitis.
Pigmentation of spleen.
Fibroid nodule of left lung.
Œdema of lungs.

Examination of Deer No. 2.

Young female received at Bender Laboratory, March 11th.

Carcass is frozen solidly. Autopsy March 12 at 3 P. M. No external evidence of injury. Emaciation is extreme, all subcutaneous and peritoneal fat absent. With the exception of the liver all organs are normal.

Liver.—Is greenish-brown in color, soft and flabby. On section are found several small cavities containing dark grumous material. From these cavities three flukes (*Fasciola magna*) were removed.

Stomachs.—Contain six pounds of soft, slightly moist greenish material in various stages of digestion. This material consists of small twigs and needles of evergreens. The exact character of the evergreen cannot be determined.

Examination of Urine from Bladder.—Reddish brown in color, smoky, with slight flocculent suspension, and heavy white crystalline deposit; faintly alkaline in reaction; odor "piney," like hemlock; specific gravity, 1,004; presence of albumen demonstrated by heat and acetic acid, and also by nitric acid test. (This albumen apparently due to the presence of hæmaglobin derivatives set free by freezing). No sugar; no bile. Sediment; abundant calcium oxalate and triple phosphate crystals; few epithelial and red blood cells, and bacteria.

In the *contents* of *intestines* were found fluke eggs and eggs resembling those of *strongylus* family. No adult worms were found.

Bacteriological Examination.—

Cultures from heart's blood, vena cava, and spleen, sterile.

Cultures from kidney, lung, and liver contain a bacillus of the colon group. In the kidney a few colonies of the *streptococcus* were found.

Histological Examination.—

Kidney and muscles of trunk and limbs normal. Spleen and lymph nodes contain much old blood pigment; liver, fibrous thickening with pigmentation of tissue about fluke cavities.

Pathologic Diagnosis.—

Extreme emaciation.

Fluke disease of liver.

Localized chronic hepatitis.

Pigmentation of spleen and lymph nodes.

Examination of Deer No. 3.

Received at Bender Laboratory in frozen condition on March 4th; autopsy March 6th.

Body that of a medium-sized male deer. Legs flexed upon body and also at the knees and elbows. On right side of head half an inch above alveolar process of jaw and one and one-half inches in front of orbit is a round hole in the skin. This hole communicates with an old healed sinus, running through the hard palate from the right to the left side, communicating with cavity of mouth. The first two teeth on the right side and the third and fourth teeth on the left side have been knocked out. This hole is probably the track of a bullet. The wound cavity in the hard palate is

filled with twigs. There is a complete absence of subcutaneous fat. On opening the peritoneal cavity a small amount of blood-stained fluid is found therein. The omentum contains absolutely no fat. Peritoneal cavity is free from any evidence of inflammation and is still in slightly frozen condition.

Pleural Cavities.—Free from adhesions or excess of fluid.

Lungs.—Voluminous; pinkish in color; smooth and glistening on surface; everywhere crepitant. On section appear normal.

Heart.—Normal.

Spleen.—Normal.

Adrenals.—Normal.

Pancreas.—Normal.

Kidneys.—Firm; red in color; surfaces smooth. Capsule strips easily. On section there is an opaque whitish zone between cortex and pyramids; otherwise appear normal.

Liver.—Greenish-brown in color and rather soft in consistence. The surface is smooth but presents several swellings on the surface of the liver which are very soft on pressure. On cutting into them they prove to be cysts in the liver substance which contain liver flukes and necrotic material. Seven flukes (*Fasciola magna*) were found in the liver.

Stomachs.—Apparently normal. Weight, with contents, three and one-half kilos. Stomachs contain two and one-half kilos (five and one-half pounds) of greenish homogeneous granular material, in which can be made out some hemlock and spruce needles. Mucosa seems apparently normal except for some post-mortem softening. The mucosa of the upper part of intestines appear normal. In the large intestine, however, there is an area about two meters in length, in which there is considerable congestion. In this region the intestine contains some blood staining mucus.

Examination of fæces before autopsy discloses fluke eggs and others resembling those of the *strongyli*. Numerous small bodies which resemble *strongylus* embryos are found, but no adult worms. Lying, however, on the mucosa of the trachea, 15 to 25 cm. above the diaphragm, is a small round worm (*megastrongylus*) about two cm. in length.

Bacteriological Examination.—

Cultures from heart's blood, vena cava, and spleen, sterile. Lung cultures yield a variety of organisms apparently the result of post-mortem invasion.

Histological Examination.—

Adrenal gland, lung, œsophagus, and muscles of trunk and limbs normal. The spleen contains much old blood pigment. Wound of head shows dense scar tissue inclosing vegetable fibres.

Liver.— Extensive fibroid induration with disposition of large amounts of pigment. Fluke eggs are numerous in the walls of abscess cavities.

Pathologic Diagnosis.—

Extreme emaciation.

Bullet wound of upper jaw and palate.

Fluke disease of liver.

Megastrongylus in trachea.

Eggs and embryos (*strongylus?*) in intestine.

Chronic intestinal hepatitis.

Pigmentation of spleen.

Examination of Deer No. 4.

Carcass received in frozen condition, March 23d; autopsy March 24th at 2 P. M.

Specimen of trunk only, head and extremities having been removed before shipping.

Trunk, that of a medium-sized deer. External examination of trunk negative. Subcutaneous and muscular tissues over abdomen show dark greenish discoloration. Subcutaneous and inter-muscular connective tissues of abdominal wall show no evidence of fat.

Pleural Cavities.— Both similar. Pleural surfaces smooth and glistening. No free fluid. No adhesions.

Lungs.— Both similar. Collapsed, light pink in color. Everywhere crepitant. On section dry and apparently normal.

Pericardial Cavity.— Negative.

Heart.— Pericardium, endocardium, and valves, normal. Muscle firm, brownish red in color.

Aorta and *Vena Cava.*— Negative.

Abdominal Cavity.— Serous surfaces smooth. No free fluid. Abdominal wall in contact with small intestine shows greenish discoloration. Viscera in region of liver and diaphragm are partly frozen.

Mesentery and *Omentum.*— Entirely devoid of fat.

Gastro-intestinal Tract.— Stomachs contain 6,000 gramms (13.2 pounds of food, consisting for the most part of finely-divided evergreen leaves (hemlock and spruce). Contents of small intestine greenish semi-fluid material. Contents of colon consists of formed fæces. Mucosa of stomachs and intestines negative.

Spleen.— Normal.

Adrenals.— Normal.

Kidneys.— Microscopically negative.

Liver.—Weight, 1,100 gramms. Dark slaty-green in color. Within the substance of the liver are one large (6 to 8 cm. in diameter) and two smaller (2 to 3 cm. in diameter) cavities with irregular outlines and gallery-like extensions into surrounding liver tissue. These cavities contain a dark-colored grumous material and twenty-one flukes. The larger cavity is situated near the upper surface of the right lobe, adjacent to the diaphragm and vena cava, and the smaller cavities near the centers of the right and left lobes.

Bacteriological Examination.—

Negative.

Histological Examination.—

Same general conditions as in Deer No. 1, No. 2 and No. 3.

Pathologic Diagnosis.—

Extreme emaciation.

Fluke disease of liver.

Localized chronic hepatitis.

Pigmentation of spleen.

Summary.—From the above descriptions it will be seen that death did not result from an acute bacterial infection as a careful bacteriological examination of each animal was negative. The suggestion in regard to foot-and-mouth disease has not been confirmed. No lesions of tuberculosis existed.

The constant and prominent features are (1) extreme emaciation, and (2) fluke disease of the liver. The first, indicative of malnutrition, points to starvation as the cause of death. Opposed to this, however, we have the knowledge that in each animal, the stomach and intestines contained, respectively, a comparatively large amount of food and fæces. If death was due to starvation, we must assume that the material eaten possessed insufficient nutritive value. It is to be regretted that a more thorough examination of this material was not made. The whole twigs examined appeared to be hemlock and spruce. (A sample of these I inclose for inspection.)

From the evidence of guides, hunters, and others it is evident that fluke disease of the deer is a common, if not constant condition, and that this lesion alone is apparently insufficient to account for death. On the other hand it is possible that this infection with the great degree of blood destruction accompanying it, might in connection with the insufficient food supply of winter, lead to considerable fatality. Histological examination of the liver of each animal shows marked chronic inflammation, while the spleen of each exhibits evidence of extensive blood destruction. I am,

therefore, strongly of the opinion that these two factors—poor food supply and fluke disease—are responsible for the death of these animals. In regard to this possibility I wrote to Dr. Chas. Wardell Stiles, Consulting Zoologist of the Bureau of Animal Industry, Washington, D. C., giving him complete data of the situation. In his reply, Dr. Stiles says: "Several outbreaks of liver fluke disease in deer have been reported and, if the infection is severe, I think it very possible that that parasite is responsible for the trouble you are investigating."

I regret that after exhausting every promising method of investigation I cannot come to a more definite conclusion.

Respectfully,

RICHARD M. PEARCE.

DR. WARD'S FINDINGS.

June 5, 1904.

Hon. DEWITT C. MIDDLETON, *Forest, Fish and Game Commissioner:*

MY DEAR SIR.—To accompany Dr. Pearce's report on the autopsies of four deer which died in the Moose River region, during the past spring, I have been requested by Colonel Fox, the Superintendent of Forests, to add some remarks of a general character.

Almost every spring, reports come from some portion of the North Woods that an unusual number of deer have died. These reports spread rapidly, are usually greatly exaggerated as they pass from one reporter to another, and it is very difficult to ascertain the exact truth. In order to get some *facts*, Colonel Fox and I wrote many letters to actual winter residents in various parts of the Adirondacks and received thirty-nine replies. From these it is perfectly clear that in most localities the deer wintered well, some of the writers estimating the mortality as no greater than usual, and a few as being even less.

On the other hand, in the two localities the number of dead this winter appears to be larger than usual. Mr. Elbert Parker, who is in charge of Mr. Robert C. Pruyn's preserve, near Newcomb, Essex county, writes that he has himself found three dead deer on the preserve, and estimates the total deaths this winter at 25 to 50. On a preserve of about 15,000 acres this is certainly a large number. In the same region, near the edge of the burned district, in Township 20, adjoining the Pruyn preserve, Mr John Anderson, of Newcomb, reports that quite a number of dead deer have been found. Mr. A. J. Chase, also of Newcomb, says that he has not been

around much himself, but hears that 12 or 15 have been found in the Tahawus Club grounds. He closes his letter, however, by expressing the opinion that the mortality has been exaggerated and that we will find that there are plenty next fall. Mr. David Hunter, Tahawus, thinks the condition of deer about medium. He knows of fifteen being winter-killed and thinks that there are probably many more.

As to the rest of Essex county, reports appear to be quite different. Mr. H. G. Alford, of Newman, in the town of North Elba, Essex county, says that the reports from the district bounded by Newcomb on the south, Long Lake on the west, Saranac river on the north and Lake Champlain on the east, show that not a single carcass has been found. Since the Pruyn preserve is in the southwest portion of this district, this report is manifestly not literally true, but is probably approximately so for the rest of the region. Mr. B. R. Brewster, also of Newman, says that he has been in the woods himself and does not think that any dead deer have been found in Essex county. Mr. David G. Helms, Long Lake, knows of only two dead deer being found, and thinks that they wintered very well. Mr. John Shandrow, Blue Ridge, Town of North Hudson, Essex county, saw one carcass in February, near Lake Henderson, but thinks that the deer wintered as usual. Hon. George A. Stevens, Lake Placid, Essex county, says that he has been in the woods a great deal this winter, having two lines of sable traps, one fifteen and the other twelve miles long. He saw many signs of living deer, but not a single dead one. He says "the deer have not suffered much in this section. My information is from actual travel in the woods." This evidence is much more reliable than what some one has heard that some one else told his informant.

It the above information is correct, it is clear that most of the deaths in this region were in two preserves, that of the Tahawus Club and Mr. Pruyn's. In this connection it is interesting to note the reports from other preserves. Byron P. Ames, of Ne-ha-sa-ne Park, Dr. Seward Webb's preserve, says "we found thirty dead deer in the Park. Much ground was burned over last year and destroyed their food. Six of us went through the woods and lopped down small trees; otherwise many more would have died." Hon. Warren Higley, President of the Adirondack League Club, whose preserve covers 67,000 acres, writes that five dead deer were found in the Little Moose district; and seven in the Bisby district. As to the Honnedaga district, Mr. Nelson and his son, on March 13, 14 and 15, went through the north part of Township 5, Yule Brook, Cobble Stone creek and headwaters of the Indian river, into Township 8 and back through Township 7 to Forest Lodge, without finding a single dead deer. "There were

hundreds wintering in this locality in fine condition, more around Honnedaga lake than have ever been known before." In two districts of this preserve there appears to have been a considerable mortality; in the third district none at all. It is to be noted that the waters of the Bisby and Little Moose districts run to the Moose river, while those of the Honnedaga district run to West Canada creek. In the one watershed the mortality was considerable, on the other practically nothing at all. Mr. E. H. Johnson, Superintendent of the Whitney preserve of 59,000 acres, writes that they have found a great many dead deer in this preserve, mostly young ones and old bucks. They seem to have died mostly where they had to eat balsam. They just seem to curl up and freeze to death. We found a number with their ears frozen. "I consider the mortality due entirely to the severe winter." Mr. E. LeBoeuf, of Faust, reports that many died on the Kildare preserve.* Mr. W. Scott Brown, Superintendent Adirondack Mountain Reserve, Beede's, Essex county, reports only two dead deer found in their preserve. This is the only exception as to the preserves from which we have had reports.

As I understand the matter, your attention was called to this subject this year by the reported great mortality in the Moose River region, a considerable part of which lies in the Adirondack Club Preserve, though the waters drain a region some miles to the north of it.

There is no evidence of any unusual mortality in any other part of the Adirondack region. Mr. James M. Wardner, Rainbow, says that the deer wintered well and not a single carcass has been found. Mr. C. H. Bennett, Raquette lake, writes that the deer have not died of starvation. He has visited several yards personally during February and March and found them doing well. Mr. Robert Snell, Northville; Mr. J. D. Morley, Lake Pleasant; Mr. E. P. Gale, Gale, St. Lawrence county; Mr. A. H. Thomas, Warrensburgh; Mr. Wm. Merrill, Baker's Mills, Warren county; Mr. W. Scott Brown, Beede's, Essex county; Mr. Wm. Humes, Harrisville, Herkimer county; Mr. Englebert Fisher, Bleecker, Fulton county; Mr. D. Norton, Glenfield, Lewis county; Mr. F. M. Abrams, Piseco; Mr. Martin Boh, Morehouse; Mr. E. LeBoeuf, Faust; Mr. Tyler M. Merior, Blue Mountain Lake; Mr. F. F. Smith, Loon Lake; Mr. Oliver St. Marie, Indian Lake; Mr. W. R. Howland, South Russel, St. Lawrence county; Paul Smith, Jr., Paul Smith's; and Mr. Willard Boyce, Saranac Inn, all agree that the mor-

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*Mr. Willard Boyce, Saranac Inn, writes that Mr. Redford, superintendent of Mr. Rockefeller's preserve, reports that twenty dead deer have been found on that preserve. He seems to think that more will be found, and has men patroling their lines.

tality has not been greater than usual, and some of them think that it has been rather less. In many regions the number of living deer, in excellent condition, is reported as unusually large.

Mr. Wellington Kenwell, who lived for many years at Indian Plains, or Moose River Clearing, summer and winter, writes at considerable length. He says that the number of deer dying on the south branch of the Moose river was considerable, but far below the winter of 1894–95, and no more, in proportion to the number living then in other localities. Deaths were generally due to the severe cold. Baker and Gray saved the lives of many deer by putting out hay, sprinkled with brine; deer collected in droves of fifty and cleaned it up. The fact is that on the South Branch of the Moose the deer increase more rapidly than they are killed off, and there is not food enough for so many. "To diverge a little, I would say that very few of the modern guides get away from the beaten roads and bar-rooms during the winter, so their conclusions are of no value and apt to be misleading."

Mr. Richard Crego, President Brown's Tract Guides' Association, writes from Big Moose, that they found eighteen dead deer and a good many weak ones that will not Spring through. They were nearly all found on Township 41, east of Big Moose. Forest fires and lumbering, west of Township 41, drove the deer into that township, where there was some green timber, but not enough to keep them all alive. He employed guides to cut browse and carry to the deer. He attributes the deaths to starvation. It was from this region that three carcasses were sent to Professor Moore, of Cornell, and four to the Bender Laboratory. It is difficult to understand how the four that we had could have died of starvation alone with hemlock and spruce twigs in their stomach weighing from $5\frac{1}{2}$ to 13 pounds.

That more deer die in the woods during every winter than during the summer is undoubtedly true. These deaths are due to what are called "natural causes." Of course, if a deer dies of nothing else he will eventually die of old age, and this is, in point of fact, the only really *natural* cause of death. But undoubtedly, in the ordinary use of words, extreme cold and lack of a sufficient amount of proper food, which may reach the point of simple, plain starvation, are included among natural causes. Again, it is certainly true that these three conditions operate together. That is, a deer in the prime of life will endure and live through an exposure to cold and a privation of food which would kill an old one, or a very young one. This accounts for the fact, noted by almost all guides, that in ordinary winters, of the deer found dead the majority are old, and next in order come late fawns. Many of the old ones are found to have lost their teeth,

and cannot cut and masticate their food. Many report that more old bucks are found than old does. For this it seems difficult to account.

There is a great diversity of opinion as to the age attained by deer in a free state, and it does not seem probable that the question can ever be definitely and positively settled. Some experienced woodsmen place it as low as ten years; others as high as twenty or even twenty-five. Mr. Thomas Blagden, of Washington, D. C., while hunting at Wolf Pond, in 1874, captured two fawns, which he took home. The buck became so ugly that he was obliged to kill him; but the doe lived to be twenty and then died by accident, being perfectly hale and hearty up to the last day. He informs me that it is his opinion that many deer in freedom attain this age.

There seems to be also some diversity of opinion as to what constitutes good food for deer. There seems no doubt that in summer they eat all kinds of grasses, the leaves and twigs of trees and shrubs, and Judge Caton, in his admirable work on The Deer of America, adds, "at least a great variety of weeds, especially the bitter sorts, the seeds of grasses, the fruits of trees, wild apples, plums and cherries, acorns, and all sorts of berries and rose apples, and all sorts of grain and seeds to which they have access." "The Virginia deer alone seems capable of masticating the hickory nut." He finds that for winter feeding the best thing of all is "a fodder consisting mostly of weeds, no matter how large and coarse, well cured." Many of these foods are not to be found in the Adirondacks at any time, and during our winters, with from 2 to 4 or 5 feet of snow on the ground, the food is practically limited to the bark and boughs of the evergreen trees—cedar, spruce, hemlock and balsam. As early as about March 1st, and while the snow is still deep, to this dietary may be added the buds and twigs of the soft maple, of which the deer are very fond and which must be very nutritious. It is generally admitted that deer will winter well on these if the supply is sufficient, except that some guides contend that they will never eat balsam if any of the other branches can be obtained, that they do not thrive on it, and some even go so far as to say that it is absolutely poisonous to them. I do not believe that there is any good ground for the latter opinion, and many good observers are of the contrary opinion—that they do just as well on balsam as on any of the other kinds of food above mentioned.

The deer sometimes eat the witch-hopple, and the general opinion seems to be that this is not good for them. In the winter of 1902–03 Mr. Blagden had, in his deer-park, near Saranac Inn, forty-eight deer in an enclosure of thirty-one acres, and they were artificially fed, in part. He

lost eight bucks and one doe. "The bucks were fenced off in a marsh by themselves, with one exception." The "only way I can account for losing so many bucks was from their drinking the swamp water, or from eating the witch-hopple with the sleet frozen to it. This latter reason, by the way, is a notion I have gained through the old guides, who believe in it, and to it I am something of a convert, because the deer have diarrhœa after such conditions." During last winter, in the same park, he lost only two deer, both does, one from old age, having lost all her teeth, and the other from having her back broken by a limb of a tree falling on her during a heavy wind. Mr. Blagden also finds that deer "care more for the rankest weeds than the choicest grass. After experimenting with all kinds of hay I found they prefer alfalfa to all others."

That deer in the wild state are subject to epidemic of infectious diseases, which carry them off in large numbers, there can be no doubt. Judge Caton, at page 341 of his work, already referred to, says, "Such accounts as I have noticed have, however, been confined to the Virginia deer," which is precisely the only variety that we have in the Adirondacks. In the following page he describes what has been called "big jaw," commencing with a swelling under the lower jaw and eventually involving the whole head below the eyes.

Deer in the Adirondacks have been reported as sickening and dying with what resembles "foot and mouth disease." It is reported that both these diseases, which are almost undoubtedly infectious and very likely contagious, are accompanied by diarrhœa. Careful inquiry among those who have seen the dead deer this winter, in the Moose River region, have uniformly resulted in the statement that no such conditions existed.

We come now to consider the cause of death of the four deer that were sent us for examination, with the supposition that the other deer which died in the Moose River region succumbed to the same cause that these did. I have little to add to what Dr. Pearce says. While many of the findings are negative they are not unimportant. These deer did not die of "big-jaw," or "foot and mouth disease," or tuberculosis, or any infectious or contagious disease of any kind, and it is certainly important to establish that fact.

They did not die of starvation alone. These four stomachs contained from 5.5 to 13.2 pounds each of evergreen twigs and leaves. In the first stomach many of these had not been affected by the digestive process at all and specimens sent to your office were there identified as being spruce and hemlock, so that the question of the poisonous character of balsam is not involved. And again the degree of emaciation was not as great as would

occur if starvation was the sole cause of death. In such cases the muscles disappear almost entirely, as well as the fat under the skin and in the abdominal cavity, and a deer weighing 150 pounds in health would not weigh more than fifty or sixty if dead of starvation alone. No such degree of emaciation existed in any one of these four deer. No doubt, however, a less degree of malnutrition would cause them to succumb to extreme cold, such as we had last winter.

It has been suggested that they may have died of thirst, the cold having been so great as to freeze over their usual drinking places. There certainly was plenty of snow on the ground, and the question arises whether they ever eat this to slake their thirst, as other animals are known to do. Some guides tell me that they do, while others positively assert that they never do. Senator Curtis N. Douglas tells me he has himself seen them do it. In any event these deer did not die of thirst, for their muscles were not in the dry condition always found when such is the case, and the bladder of each of them contained a considerable amount of urine.

They did not die of any acid poison, such as corrosive sublimate or arsenic, for their stomachs and intestines were in a perfectly healthy condition, not a single point of inflammation being found anywhere. In the first stomach the individual leaves were easily recognizable; in the last one the food had been reduced to a soft, homogeneous, pultaceous mass; in the intestines digestion was going on naturally, there was no diarrhœa, and each rectum contained a normal amount of the usual fæcal masses.

They did not die of strychnine poisoning, for their muscles were not in the condition of tetanic rigidity and contraction which is always found under such circumstances.

They did not die from any intestinal parasite, for, while a few eggs were found, there were no developed worms worth considering.

They all had flukes in their livers—from three to twenty-one—and there is no doubt that these parasites impoverish the blood and would greatly aid malnutrition and exposure to cold in producing death. On the other hand, I have examined the livers of a great many deer killed, when in excellent condition in the hunting season, and cannot remember having seen one that did not contain as many flukes as we found in these deer. Undoubtedly it occasionally happens that a healthy deer has no flukes, but more than one guide has told me that the larger and fatter the deer the more likely you are to find flukes. The deer's liver is seldom eaten, not only on account of its containing flukes, but also because as in other animals which have not gall-bladders, it tastes bitter and disagreeable. Those who eat it at all, after slicing it up, soak it for hours in repeated changes of water,

or else, covering it with a thin cloth, bury it for twenty-four hours in damp sand, before cooking it. The idea of eating any portion of a liver in which parasites are found is certainly repulsive; and yet those guides are probably right who say that if the sacs containing these flukes are cut out the rest of the organ is a perfectly safe article of diet. It is well known that the fluke, so common in sheep, is the direct cause of thousands of deaths by what is known as " sheep-rot." That parasite belongs to the same family, but not the same species, as the worm found in the deer's liver, and the latter is never, so far as known, the direct cause of death, certainly not of any such epidemic as occurs among sheep.

But while flukes may be a contributing cause of the death of poorly fed deer, in extremely cold weather, this does not explain the unusual mortality in the Moose River country, for there is every evidence that flukes are just as common in other parts of the woods as they are there. Last winter was undoubtedly unusually cold; but it was just as cold at Saranac, and in Essex county, and in Maine, Vermont, New Hampshire and Canada, as on the Moose river. Mr. George H. Moses, Secretary of the New Hampshire Forestry Commission, writes, " The winter was unusually long and severe and deer have been driven further north than usual; but there has been no unusual mortality." Mr. H. G. Thomas, Commissioner of Fisheries and Game, of Vermont, writes, "Have made thorough inquiry throughout the State and have not heard of any deer being found dead from the extreme weather. Reports published in the press are not well founded." Mr. N. E. Cormier, Provincial Game Warden and Fishery Overseer, at Aylmer, Que., writes, " Have lost many deer from snow being so soft and deep, with no crust, that they could not reach their feeding-grounds. Where the snow was not deep have lost very few." Mr. E. E. Ring, Secretary of the Fish and Game Commission, of Maine, writes, " There was very little mortality among deer in this State the past winter, although it has been one of the most severe on record. One of our wardens, near the Canadian border, reports having found a few small deer which had evidently died of exposure and starvation. This is the only case reported."

In conclusion we regret to be forced to admit that we have been unable to satisfactorily account for the unusual mortality in the Moose River region, which, by the way, is not limited to this past winter, but occurred in the winter of 1894–5, and probably in other seasons as well. The snow was deeper than in many other places; but the weather was no colder than elsewhere; flukes are no more common than elsewhere. The stomachs of the deer that we examined were full of food; they did not die of thirst; and there was no infectious disease among them. That there may be some

local cause seems possible. It cannot be the air, or the water. It is possible that the food may in some way be improper, and I would suggest that, if the mortality is repeated another year, investigation be directed particularly in this direction.

Undoubtedly the snow was deeper in the Moose River region, where most of the deaths occurred, than in other parts of the Adirondacks, and lasted longer. Senator Douglas informs me that his lumber company, at McKeever, had to spend several thousand dollars more than usual in keeping their lumber roads in proper condition; that it commenced to snow in the latter part of November, and that more or less fell almost every day until March.

The most plausible theory that I have ever heard to connect the mortality of deer with deep snow and protracted, severe, cold weather, is that advanced by David Charbonneau, a guide, at Old Forge. He says that after the disappearance of their summer food, the deer are in the habit of subsisting on the roots of the brakes and the "ground hemlock" — a variety of the yew; that this is nutritious food for them; that to get at these two articles of diet, they habitually paw away the snow until it gets too deep; that finally they begin to consume the boughs of the evergreen trees only as a last resort; that the boughs are a poor kind of food, especially poor in heat-producing power; that the deer get along on them in ordinary winters for three or four weeks very well; but that when obliged to subsist on boughs alone for five, or six, or eight weeks of very severe weather, numbers of them succumb not to starvation alone, but to the combined effect of starvation and cold. They may be found frozen to death with their stomachs full of this unnutritious food. This theory would account for the four deer which we examined, and is the only one so far advanced that would.

I have the honor to be,

Very respectfully,

SAMUEL B. WARD.

AN INTERESTING LETTER

SARANAC INN, N. Y., *June* 2, 1904.

DR. S. B. WARD, 281 *State street, Albany, N. Y.*:

MY DEAR DOCTOR.—In reply to your letter of May 31st, asking for information regarding my deer, I will endeavor to give you a short synopsis of my experience, which has been most varied and interesting:

During the fall of 1874, when hounding was allowed, I was on one of my hunting bouts when two fawns were driven into Wolf Pond by the dogs. They proved to be a buck and doe, and I took them to my home at Washington in order that I might watch their habits, and so learn something that might possibly aid me in my favorite pursuit of deer hunting. It is needless to say I learned much, and became so interested that I made the subject quite a study, and from those two caught in the Adirondacks I have raised several hundred. Not being a believer in inbreeding I have been careful to secure new bucks from time to time, doing so from those I have obtained from the Adirondacks or from the Zoological Parks.

As to the life of a deer, I am of the opinion they attain more than the average age of most animals. Unfortunately, I cannot prove this. Of the two fawns caught by me in 1874, the buck became so ugly I was obliged to kill him; the doe lived to be twenty years old, and was hale and hearty in every way up to the time of her death. She was gentle and almost human, and loved by every member of my family, when to my grief she caught her head through the bars of a fence, and in trying to extricate herself broke her neck.

During the spring of 1902 I brought a carload of deer from my home at Washington and liberated them in the little park of thirty-one acres here at Saranac Inn, which through your kindness I was able to obtain. There were in all forty-eight deer. As the new park at the Inn was of swamp land, rich in vegetation, my old guide thought there would be an abundant supply of food for fifty deer. This, however, proved not to be the case, and we were obliged to feed them. The following winter I lost eight bucks and only one doe. The bucks were fenced off in the marsh by themselves with one exception while the does and the one buck had the largest range. The doe which died came from South America, and was presented to me by Admiral Greer. The only way I can account for losing so many bucks was from their drinking the swamp water or their eating the witch-hopple with the sleet frozen to it. This latter reason, by the way, is a notion I have gained through the old guides, who believe in it, and to it I am something of a convert, because the deer have diarrhœa after such conditions.

My does last summer had ten fawns, and of the lot there were two sets of twins.

I was most fortunate with the deer last winter in contrast with the preceding one, losing but two does, one from old age, and the other from having her back broken by a limb of a tree falling on her during a heavy wind. I had no record of the age of the old doe just mentioned, but, as my man

informed me, she was entirely without teeth, I infer she must have been pretty old.

I have now in the park of thirty-one acres, thirty-five deer. I have, of course, to feed them, using corn and a mixture of bran and meal. During the summer I have my men cut for them as much wild food as possible, and have always found that they care more for the rankest weeds than the choicest grass. After experimenting with all kinds of hay, I found them to prefer alfalfa hay to all others.

Now, my dear doctor, I must come to a close. I could go on forever, as my stock of information is almost endless on account of my experience.

Should there be anything more you or your friends would like to know, call on me freely.

With kind regards, believe me,

Very sincerely yours,

THOS. BLAGDEN.

ANOTHER INQUIRY.

NEW YORK STATE VETERINARY COLLEGE,
CORNELL UNIVERSITY,
ITHACA, N. Y., *June* 3, 1904.

Forest, Fish and Game Commission, Albany, N. Y.

DEAR SIRS.— At the request of the Commissioner of Agriculture I went with Dr. Kelly, of Albany, on March 16, 1904, to Big Moose in the Adirondack Mountains to make an investigation into the cause of death of wild deer that were reported to be dying of some infectious disease.

The examination of such deer as could be found, in the time at my disposal there, failed to reveal the presence of any infectious disease. It was learned from the guides that it was young and very old deer that were dying and that the most probable cause of death was the lack of food occasioned by the very deep snow. The guides were requested to send me at Ithaca for a more thorough bacteriological examination all deer that they could find that had died recently.

Sunday morning, March 20, one old buck and two fawns were received. These were very carefully examined. They were all very poor and their stomachs were practically empty. Their feet and mouths, like those of the deer examined in the woods, were practically normal, thus excluding the

dreaded "foot and mouth" disease. There were no lesions in the organs suggestive of *Wildeseuche* which was feared. All of the culture media inoculated from the organs of these deer remained sterile. I was unable therefore to find any evidence of an infectious disease among them.

There are many reasons to suspect that the deer died from starvation. The President of the Brown's Tract Guide Association, Mr. Richard Crego, told us that the deaths during this past winter were not in excess of those during former winters of like severity.

Respectfully,

V. A. Moore.

Adirondack Game Report for the year 1905

Hon. JAMES S. WHIPPLE, *Forest, Fish and Game Commissioner:*

SIR.—Your prediction as to the satisfactory condition of the deer and other animals in the Adirondacks is fully carried out by the facts and figures contained in the annual compilation which I now have the pleasure of presenting. Good hunting prevailed, and the number of deer killed was considerably in excess not only of last season but also of many previous seasons. The number of unusually large deer secured was greater also than usually falls to the lot of the hunters, and the actual weights given show that the repeated assertion of the Department is true that the deer reach their best condition in the Adirondack wilderness. The figures carry with them the best possible argument that could be made in favor of continuing the present satisfactory laws for the protection of these animals.

The statistics of bear, elk and beaver also form a highly satisfactory exhibit. The work which the Department has done in introducing and protecting the elk and beaver has met with general approval, and the colonies of beaver already form an especially attractive feature of the woods. A careful compilation of the accident cases has also been made for the information of all concerned.

A comparison of the shipments of carcasses, saddles and heads of deer, by the express companies for the past season, with the shipments for the preceding five years, taken from our office records, follows:

The Annual Kill

YEAR.	CARCASSES.	SADDLES.	HEADS.
1900	1,020	89	95
1901	1,062	103	121
1902	1,354	113	193
1903	1,961	145	188
1904	1,618	124	152
1905	2,196	108	180

Concerning the Adirondack deer hunting Mr. W. E. Wolcott of Utica wrote to Forest and Stream on December second as follows:

"In the northern part of the Adirondacks hunters have met with excellent success this fall, while in the southern portion they have, as a rule, been but poorly rewarded for their time and labor. From Lake Placid, Tupper Lake, Chateaugay Lake, Wolf Pond, Plumadore Pond, McCullom's and other points in the upper section of the wilderness it is reported that more deer have been killed than ever before in one season, and it is said that in the Cranberry Lake region there have been more deer this fall than for some years past. In the southern and southwestern portion of the Adirondacks, however, the number has been small in comparison with other recent years. This is true of the Moose river, Beaver river, Black river, and West Canada Creek regions, Piseco Lake, Honedaga Lake, the Bisby Lake, Fulton chain, Raquette Lake and Big Moose Lake, according to the best information now obtainable, although why such should be the case is not easy to explain. It seems strangely contradictory and almost inexplicable that on the northern slope of the Adirondacks the best deer hunting ever known should be enjoyed, while in the southern portion of the wilderness sportsmen should meet with comparatively poor success * * * The most common explanation is that the undergrowth was exceedingly dense and the leaves remained on the trees and bushes until very late. With November snow came and the hunting was materially improved."

The large increase in the number of deer secured by hunters during the past season again shows the uselessness of guessing at the kill, as is always done by residents of the woods, long before the accurate figures are available. This increase, with the facts that the deer secured were in unusually good condition, and that no epidemic of any kind has prevailed during the past year, will be a matter of great satisfaction to the sportsmen of the State.

Detailed statements of the actual shipments, furnished by Supt. J. L. Van Valkenburg, of the American Express Company, and Supt. T. N. Smith, of the National Express Company, follow:

Shipments of Deer from Points in the Adirondack Region Season of 1905

MOHAWK AND MALONE RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Beaver River	95	7	12
Big Moose	35	3	
Bog Lake	2		
Brandreth Lake	1		2
Clear Water	48	1	1
Childwold	24	3	
Eagle Bay	1		
Floodwood	27	1	
Forestport	40	4	
Fulton Chain	31	1	
Hinckley	2		
Horseshoe	1	1	8
Lake Kushaqua	15		2
Lake Clear Junction	5		
Lake Placid			3
Little Rapids		2	
Long Lake West	83	3	3
Malone	8		10
McKeever	38	2	2
Loon Lake	21		
Mountainview		1	
Minne-ha-ha	8		
Ne-ha-sa-ne	1		11
Onekio	4		
Otter Lake	20		
Owls Head	2		
Paul Smith's	19	3	10
Pleasant Lake	3		
Poland	38	1	
Piercefield	82	8	1
Prospect Junction	1		
Rainbow Lake	1	2	
Raquette Lake	45	6	
Remsen	8		

MOHAWK AND MALONE RAILROAD — (*Continued*).

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Saranac Lake	6	3	
Saranac Inn	5	3	
Tupper Lake Junction	69	8	
Woods Lake	12		
White Lake Corners	21	2	
Total	822	65	65

NEW YORK AND OTTAWA RAILROAD.

Brandon	9		
Bay Pond	10		
Childwold	8		
Derrick	39		1
Kildare	5	1	
Meno	34	1	1
Madawaski	18		
Santa Clara	25		1
Sherman Siding	4		
Spring Cove	33	1	1
St. Regis Falls	10		7
Tupper Lake	10	2	11
Total	205	5	22

UTICA AND BLACK RIVER RAILROAD.

Alder Creek	13	1	1
Barneveld	1		
Benson Mines	38	1	1
Boonville	6	2	
Carthage	3		
Castorland	12	1	
Glenfield	38		1
Harrisville	48	3	
Jayville	13		
Kalurah	3		
Lowville	24	1	
Lyons Falls	12		

UTICA AND BLACK RIVER RAILROAD — (*Continued*).

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Newton Falls	69	1	1
Oswegatchie	18	1	
Port Leyden	8		
Wanakena	69	3	7
Total	375	14	11

ROME, WATERTOWN AND OGDENSBURG RAILROAD.

Canton	8	1	
DeKalb Junction	4		2
Edwards	12	2	
Norwood	2		
Potsdam	34	4	
Richville	2		
Philadelphia	1		
Watertown	4		
Total	67	7	2

FONDA, JOHNSTOWN AND GLOVERSVILLE RAILROAD.

Broadalbin	1		
Gloversville	22	1	
Johnstown	3		
Northville	183	9	22
Total	209	10	22

LITTLE FALLS AND DOLGEVILLE RAILROAD.

Dolgeville	24	1	

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

Fonda	5		
Little Falls	7		
Total	12		

Rutland Railroad.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Bangor, N. Y.		1	1
North Lawrence	1		2
Total	1	1	3

Delaware and Hudson Railroad.

Greenwich			1
Hadley	7		1
Keeseville			2
Lake Placid			3
Loon Lake	8		
Lyon Mountain	1		
North Creek	238	4	27
Port Henry	28		
Riverside	19		2
Saranac Lake	3		
Stony Creek	104	1	
The Glen	1		1
Thurman	4		2
Ticonderoga	1		9
Warrensburg			4
Westport	2		3
Total	416	5	55

Recapitulation.

Mohawk and Malone	822	65	65
New York and Ottawa	205	5	22
Utica and Black River	375	14	11
Rome, Watertown and Ogdensburg	67	7	2
Fonda, Johnstown and Gloversville	209	10	22
Little Falls and Dolgeville	24	1	
New York Central and Hudson River	12		
Rutland	1	1	3
Delaware and Hudson	416	5	55
Total	2,131	108	180

Accurate weights of large deer shipped were particularly requested of the express companies, and the figures received show that their agents did not confine themselves this season to "round numbers," as has heretofore been the case. The list which follows shows a particularly gratifying condition existing among the Adirondack deer, and will be read with interest by students of animal life as well as by the sportsmen.

NOTABLE SHIPMENTS.

RAILROAD STATION.	CONSIGNEE.	DRESSED WEIGHT, POUNDS.
Alder Creek	S. W. Jones, Holland Patent	216
Benson Mines	R. B. Hubbard, Aldrich	200
Benson Mines	H. L. Link, Natural Bridge	210
Big Moose	Chas. Fikes, Fort Plain	208
Canton	G. Griswold, Herkimer	200
DeKalb Junction	H. Exford, Ogdensburg	244
DeKalb Junction	W. Roycroft, Utica	215
Dolgeville	F. M. Bailey, Herkimer	230
Edwards	B. Baldwin, Albion	200
Edwards	Phil. Dealing, Adams Center	214
Glenfield	H. D. Burdick, Lowville	204
Glenfield	E. B. Robson, Geneva	203
Harrisville	Geo. Merith, Carthage	200
Harrisville	Sam Ray, Watertown	220
Harrisville	W. Fish, Mt. Kisco	203
Harrisville	Sam Lord, Adams Center	201
Jayville	W. St. Louis, Watertown	200
Jayville	Geo. Cove, North Scriba	240
Lowville	Phil. Klett, Mexico	202
Long Lake West	M. Fortune, Saranac Lake	260
McKeever	W. H. Roberts, Rome	216
North Creek	F. W. Sharp, Albany	210
Northville	C. Bernhardt, New York City	210
Northville	F. A. Barrett, Cohoes	208
Northville	H. Rettis, Gloversville	212
Northville	M. H. Schmidt, Gloversville	217
Northville	E. Hammond, Gloversville	211
Otter Lake	L. M. Mogg, Cazenovia	230
Paul Smith's	Sam Sully, Buffalo	215
Paul Smith's	John Bartle, Buffalo	207

NOTABLE SHIPMENTS — (*Continued*).

RAILROAD STATION.	CONSIGNEE.	DRESSED WEIGHT, POUNDS.
Paul Smith's	C. H. Carl, Buffalo	215
Paul Smith's	John Diehl, Buffalo	220
Paul Smith's	Dr. G. F. Graf, Buffalo	218
Piercefield	W. L. Dougherty, Herkimer	209
Riverside	W. B. Hagadorn, Schenectady	190
Spring Cove	Z. Labounty, Santa Clara	225
Spring Cove	J. J. Dunnerdergar, Buffalo	216
Stony Creek	H. W. Chubb, Schenectady	235
Stony Creek	Dudley Fuller, Corinth	220
Stony Creek	W. Todd, Peekskill	215
Thurman	Ned Kipp, Ossining	265
Tupper Lake Junction	J. P. Darling, Albany	200
Tupper Lake Junction	G. Lemontague, New York City	200

A communication to Forest and Stream on September 23d, under the heading "A Magnificent Adirondack Deer," told of the shooting near Northville of a buck that weighed the day after it was dressed fully 300 pounds. Inquiry at the office of the American Express Company showed the weight recorded as 285 pounds. Further inquiry resulted in the following interesting letter:

NORTHVILLE, *October* 21, 1905.

Forest, Fish and Game Commission, Albany, N. Y.:

GENTLEMEN.— * * * The deer was weighed by I. A. Brownell in the presence of Frank Chegree of this place and Walter Scott of Brooklyn. It was not weighed at the depot where they billed it at 285 pounds on the word of Robert Brownell. Mr. Scott, Mr. Chegree and myself will all verify the weight by affidavit if necessary.

We also shipped to the Eagles, a fraternal order at Gloversville, eight other deer, including four bucks weighing 245, 230, 175 and 156 pounds, respectively. The 156-pound buck had fifteen prongs and was one of the finest heads ever seen in this part of the deer country. We also sold to Christman, of Amsterdam, a buck weighing 236 pounds and there was one killed by Mr. E. C. Roberts that weighed 250 pounds. * * *

Yours respectfully,

I. A. BROWNELL.

Other correspondence by the secretary, with reference to the deer shipments and unusually large deer reported killed in various parts of the Adirondacks, resulted in a number of letters of which the following is one of the most interesting:

NORTH GRANVILLE, *November* 27, 1905.

Forest, Fish and Game Commission, Albany, N. Y.:

DEAR SIRS.—On November 14 I started out in company with Dr. Jerome Stickney, George C. Stickney and Hiram Danby on the range of mountains south of Jay village, and while watching for those driving the thickets a large buck came along which I shot. The bullet penetrated the lungs, cutting them into mincemeat, but he made forty jumps after being shot, some of them being 16 feet long and the last two or three were from 10 to 12 feet long. He ran a distance of 25 rods but was dead when I reached him. He was shot with a soft point bullet of the 33 caliber Winchester. The dressed weight of this deer was 262 pounds and the live weight (by the method used by the Commission) was 327½ pounds. The four quarters alone weighed 228. * * * When dressing the deer all of us noticed the absence of fat on the intestines, and there was not five pounds of fat on the entire carcass. Had there been, this deer would have weighed, if in the usual condition, at least 350 pounds, if not more. This is not the only large deer in that locality, one of our party distinctly seeing another which he says was larger than the one I shot. * * * I might add that the antlers of my deer measured 21½ inches wide at the tips. * * *

Yours truly,

CARTER MCV. TOBEY.

The writer of this letter kindly offered to get one of the unusually large deer for the Commission to have mounted as a specimen of the Adirondack deer at its best, and asserted that it was his judgment, and that of several other well known sportsmen whom he mentioned, that the largest deer in the woods are found in the section from which his own came.

An Albino Deer

Several reports of the shooting of white deer appeared in the newspapers during the season, and one of these at least was authentic. Under date of December 8, Mr. John Hurley of Little Falls replying to a letter of inquiry from the secretary, wrote:

" * * * The albino deer was shot by Mr. Frank Rockwell on the Sacandaga road, about four miles from Stratford, and was a doe weighing about 125 pounds. This beautiful little animal was all white, excepting a few spots about the neck, just back of the horns, as large as a twenty-five cent piece and numbering perhaps about twenty. I did not notice the color of the eyes. When shot the doe seemed to be in the company of two bucks, much larger. The gambrel joints of this deer seemed to have quite long hair and the hair seemed to be in abundance all over the hide. In no other respects could I see that it differed from our ordinary deer. * * *"

This albino was mounted and a small pair of buck horns set on the head "to make it look better." It was displayed in several places in Albany during the winter and attracted considerable attention as an unusually handsome specimen.

Adirondack Elk

More than four years have elapsed since the elk was reintroduced into the Adirondack forest, and since that time the number of these animals has been constantly increasing,—due partly to additional liberations and partly to natural causes. On account of their wide distribution, it is no longer possible to estimate with accuracy their number, but they are known to be increasing in every Adirondack county, and when it is considered that those which were born in 1901 and 1902 are already bearing offspring, and that the elk seem to suffer less from the rigors of winter than the deer, it is probably safe to say that there are at least 250 roaming the north woods at the present time. As showing the satisfactory increase from year to year, the following table, compiled from the data given in previous reports, may be of interest.

NUMBER OF WILD ELK IN THE ADIRONDACKS.

On September 30, 1901	22
On September 30, 1902 (estimated)	80
On September 30, 1903 (estimated)	168
On September 30, 1904 (estimated)	200
On September 30, 1905 (estimated)	250

It would seem from the foregoing table that the complete restoration of the elk to our forests is merely a matter of time, and that the present herds might be depended upon to restock fully the Adirondack region in the course of ten or more years. But the experience of the past has shown those who have been concerned in previous efforts to restock a given section with any large game animals, that the unexpected is to be reckoned with as a factor liable at any time to upset what might be considered to be the ordinary course of nature, and that stock of any kind that has been newly introduced into a country, especially during the first ten years, is open to diminution or disaster which may arise from a variety of causes. That which most needs to be guarded against at present is inbreeding. The only admixture of new blood which the Adirondack elk have received in the past two years has been that of a few individuals which are believed to have escaped from private preserves in which elk are kept. The law empowers the Commission to "acquire by gift, purchase or capture, a sufficient number of wild moose and elk to stock the Adirondack region," but at present the Commission is without funds for introducing new stock, and it is again pointed out that private citizens or associations interested in the propagation of big game, would materially add to the safety and numbers of these species by generously liberating either elk or moose at their own expense in any portion of the Adirondacks. If those who are disposed to make such contributions to the State will communicate with the Commission, every facility at its disposal will be given them and full credit will follow in the succeeding annual report.

The Moose

As no appropriation for the further purchase of moose has been made since 1901, it has not been possible during the past two years to liberate any additional moose in the Adirondacks and, as unfortunately several cows were killed during the first year of the experiment, before the undertaking had received a fair impetus, the increase has been very slow and unsatisfactory. Occasionally a moose is reported as having been seen in some portion of the Adirondacks, but the number existing there to-day is entirely too few to insure the perpetuation of this animal and the result of

inbreeding alone would be sufficient to bring about the extermination of the moose in a few years, even though they were to meet with no other mishap.

The elk were never so numerous as were the moose in the Adirondacks in former times, and it is likely that no portion of the continent affords conditions better adapted for sustaining the latter species. Considering this fact and also that the moose is more esteemed by Eastern sportsmen than the elk, it would seem, in view of the success which has attended the reintroduction of the elk, that the State's endeavors to restock its forests with the king of American forest creatures should not cease because of a temporary embarrassment following the first spasmodic effort. The promoters of the moose restocking experiment continue to insist that it has not yet been given a fair trial, and that the money already appropriated will have been worse than misspent if new blood is not immediately added, so that what has been done may be safeguarded and made permanent. They maintain that the indirect benefits which the liberation of moose in the Adirondacks has already accomplished, such as the increased attention which has been attracted to that region on the part of tourists from all parts of the country, the enhanced general interest in the preservation of game, and the greater care now exercised by hunters who fear to shoot a moose in mistake for a deer and perhaps incur a heavy fine or suffer imprisonment for so doing, with the consequent decrease in the number of human sacrifices to careless shooting, have alone amply justified the initial appropriation. Moreover, the value of the experiment to science, whether it ultimately succeeds or not, is claimed by its advocates to warrant the reasonable reappropriation which will be asked by them in order to continue the work.

The law allows sixty days in which to report the shooting or trapping of a black bear, and as many of the bears killed in November and December are not reported until January or February, it has been found necessary to record here only the number of bears killed during the year closing on June 30, when the close season (July 1 to September 30) begins. For the purpose of making the records of bears killed in this state complete from the date when the new bear law went into effect (May 9, 1904) we add a table showing the number of bears reported killed between that date and June 30, 1904.

As the county of Essex is excepted from the provisions of the law, detailed records are not received, and the number of bears killed in that county during either year cannot be given.

BEARS REPORTED KILLED, MAY 9 TO JUNE 30, 1904.

COUNTY.	MALE.	FEMALE.	SEX NOT STATED.	SHOT.	TRAPPED.	METHOD OF TAKING NOT STATED.	TOTAL.
Franklin	1	. . .	. . .	. . .	. . . .	1	1
Fulton	1	1	. . .	. . .	. . . .	2	2
All counties	2	1	. . .	. . .	. . . .	3	3

BEARS REPORTED KILLED DURING YEAR ENDING JUNE 30, 1905.

COUNTY.	MALE.	FEMALE.	SEX NOT STATED.	SHOT.	TRAPPED.	METHOD OF TAKING NOT STATED.	TOTAL.
Cattaraugus	3	1	. . .	3	. . . .	1	4
Clinton	1	5	. . .	4	. . . .	2	6
Delaware	1	. . .	. . .	. . .	. . . .	1	1
Fulton	1	1	. . .	2	. . . .	. . . .	2
Greene	5	10	5	5	. . . .	15	20
Hamilton	6	2	. . .	3	. . . .	5	8
Herkimer	3	2	4	2	2	5	9
Lewis	4	. . .	. . .	2	. . . .	2	4
Oswego	1	. . .	. . .	. . .	. . . .	1	1
St. Lawrence	5	2	1	. . .	1	7	8
Ulster	5	14	1	4	. . . .	16	20
Warren	6	1	. . .	1	1	5	7
All counties	41	38	11	26	4	60	90

Records have been received of about 75 bears killed subsequent to June 30 of this year, but it is thought best to reserve the details for next year's report, which will contain the number killed to June 30, 1906. The largest bear of which record has been received was that killed in Sullivan county on November 1, 1905, by Mr. Charles Monroe. It weighed 480 pounds. Not more than four bears a year are reported as exceeding 400 pounds in weight. About 12 per cent. of those killed weigh between 300 and 400 pounds, about 32 per cent. weigh between 200 and 300 pounds, about 40 per cent. between 100 and 200 pounds, and the remainder less than 100 pounds.

Efforts to secure more accurate reports of the bears killed will be made next season, and we will also seek to arrange for a tabulation of the shipments. The only reports received from shippers during the past season came from the National Express Company, and included one bear of 40 pounds weight, consigned to E. V. Russell, of Binghamton; another of 165 pounds, consigned to Sukest, Brooklyn; one of 40 pounds, consigned to John Honecker, Buffalo, all three shipped from North Creek; one of 165 pounds, consigned to C. H. Striever, Ballston, and one of 125 pounds, consigned to Daniel Foote, of Ballston, both shipped from Stony Creek.

The Beaver

Since the publication of the last annual report, six of the seven beaver purchased by the State with the $500 appropriation granted for this purpose by the Legislature, have been successfully liberated in the Adirondacks. One of the animals died after liberation, as the result of injuries sustained some months before in a conflict with another beaver.

Through an arrangement, entered into with the Brown's Tract Guides Association, the beaver were kept during the winter in an artificial fish pond at the State hatchery at Old Forge, the guides bearing the expenses connected with their care. Mr. J. Edward Ball, of the Guides' Association, and Mr. Henry Davidson, then in charge of the hatchery, constructed three very serviceable houses, which were raised on posts just above the water, and provided with shelves covered with straw to which the beaver could retire in case of a sudden rise of the pond. In this way they were kept until

the ice left the lakes and streams in the spring, when they were carried to suitable points and liberated. During their temporary confinement Mr. Ball reports that they consumed several cords of wood which he cut for their use, eating only the bark and the small twigs. During the last week in April, Mr. H. V. Radford, of New York, who is chiefly responsible for the movement to reintroduce the beaver, with Guides Frank and Ben Sperry, Stanley Weedmark, Ira Delmarsh, E. Van Krum and J. H. Higby, volunteered their services to liberate the beaver. Two of the animals were transported overland 25 miles and turned out on a small stream entering the south branch of the Moose River, where another beaver, which escaped some years ago from the preserve owned by Hon. Timothy L. Woodruff, had built a dam. The other four were liberated on the northeast inlet of Big Moose Lake. The Moose River trio were still at the place where liberated when last heard from, but some of the Big Moose Lake beaver have moved over into the Beaver River waters twenty miles to the northwest.

During the past few years, Mr. Edward Litchfield has liberated about a dozen beaver in his preserve,— Litchfield Park, near Big Tupper Lake. Several of these have escaped to adjoining lands. There is also known to be a small native colony,— the last remnants of the original stock, inhabiting the waters northwest of Upper Saranac Lake. A conservative estimate of the total number of beaver in the Adirondacks at the present time would probably be 40.

Very great interest is taken in the liberation and preservation of the beaver by the guides and by other residents of the Adirondacks as well. In order to make the record complete the following letter received from the Secretary of the Brown's Tract Guides' Association is given:

OLD FORGE, N. Y., *September* 11, 1905.

MR. JOHN D. WHISH, *Secretary, Forest, Fish and Game Commission, Albany, N. Y.:*

DEAR SIR.—According to my promise I am reporting by letter in the matter of the beaver wintered by the Association for the Commission. About the first of May they began to get very uneasy and gave us much trouble. The one which we were told at the St. Louis Exposition was a female, and which we were obliged to keep in a separate compartment through the winter, cut its way out several times, finally cutting through

the wire partition and getting in with the five others during the night time. It was found dead in the morning and was buried. A day or so later the ice left the lake and four men were sent to the headwaters of the south branch of the Moose River with two,— a male and female as near as could be judged, and two days afterward the remaining four were liberated on the south fork of the inlet to Big Moose Lake.

Since that time one was seen as far down on the south branch of Moose River as Limekiln Falls, on the Adirondack League Club property. The latest news of them is that the south branch colony has moved further up on the stream, and has located and are cutting wood and building a dam preparatory for the winter. The Big Moose colony moved down to the lake where they evidently stayed some time unnoticed, as they cut several trees and put them into the lake. The next sign reported was that chips and sticks of their make were seen at Queer Lake, two and one-half miles south, toward Fourth Lake. Since that time no trace of them was reported until last week, when they were seen at the outlet of Big Burnt Lake on Beaver River cutting and sinking wood and evidently preparing to stay. It is reported that they are seen every day and are quite tame.

Mr. Crego writes me that he has lately seen fresh signs of beaver in a remote place but did not say where. It may be that the colony has divided and the members are locating in separate places. As the outlet to Burnt Lake is quite a thoroughfare and many people are passing up and down the stream, I would suggest that measures be taken to inform travelers, either by posting notices or in some other way, what these animals are and why they are there, and that they are protected by law.

The Moose River colony is well located as very few people will get so far back as that. I have mounted the beaver that was killed and it is at the disposal of the Commission. We found that caring for and liberating the beaver was more expensive than was expected, and expended $208.32 in the work. While we are not going to ask the Commission to bear any part of this expense, we would not object very strenuously if they should insist on doing so.

I have also to report that a cow moose was seen on "Granny Marsh" about five miles from White Lake Station and that elk tracks have been seen in the Moose River country.

Respectfully yours,

A. M. CHURCH,

Secretary.

LOST IN A SNOW STORM

Hunting Casualties—1905

The Commission is indebted to Mr. W. E. Wolcott, Secretary of the Black River Fish and Game Protective Association, for the following list of Adirondack hunting casualties:

July 11. Phillip Pervelle, aged eight years, mistaken for a deer in the woods near Danby, St. Lawrence county, and fatally shot.

September 1. John Moroughan, Jr., aged seventeen, of Harrisville, Lewis county, accidentally shot and killed by a companion while deer hunting near that place.

September 4. Thomas Gifford, aged seventeen, of Gloversville, Fulton county, accidentally shot and killed by a companion while deer hunting near Northville.

September 10. Varisse Varien, age not given, of Tupper Lake, Franklin county, accidentally shot in the hip while hunting in the Moose Creek district. A companion's gun was discharged by a branch striking the trigger.

September 17. Mrs. D. L. Jordan, of Freeport, Nassau county, blinded in one eye by a bullet rebounding from a rock or tree in the forest while hunting deer near Twitchell Lake.

September 27. Peter LeFever, aged fourteen, killed by the bursting of his gun while deer hunting at Moose River, near Boonville.

October 3. George Mosher, Jr., aged twenty-one, of Thurman, Warren county, fatally wounded by a companion who mistook him for a deer while hunting near West Stony Creek.

October 5. Alonzo Dudley, a well known guide, drowned in Long Lake while on a hunting expedition.

October 10. Roy Sanders, of Herkimer, Herkimer county, wounded by the accidental discharge of a gun while deer hunting at Wilmurt.

October 16. Milton D. Stone, Jamestown, Chautauqua county, instantly killed while hunting, by the accidental discharge of a companion's gun.

October 22. Leon Bates, a boy residing in Ilion, Herkimer county, accidently shot while hunting near his home—not serious.

October 27. Burton Van Orman, of Lake Placid, Essex county, found dead at the foot of a cliff in the woods over which he had evidently fallen while returning at night from a deer hunt.

November 2. Calvin Hill, of McKeever, Herkimer county, accidentally shot by another hunter who mistook him for a deer—not serious.

November 6. Albert B. Fuller, of Utica, Oneida county, and Chas. Rose, his guide, drowned in North Lake while deer hunting.

November 10. Fred. Pinkstone, aged fourteen, of Utica, Oneida county, accidentally shot by a companion while out hunting, and died from loss of blood.

November 17. Jacob Kehr, aged forty-two, of Malone, Franklin county, shot through the head with his own rifle while deer hunting. The accident occurred on Immortelle Mountain.

November 22. An elderly man named Kinkade, while cutting wood near his home at the Narrows River, was mistaken for a deer by a hunter named Stanley Fanjoy, and killed by a rifle ball.

Respectfully yours,

JOHN D. WHISH,
Secretary.

Albany, N. Y., Sept. 30, 1905.

Adirondack Game Report for the year 1906

Hon. J. S. WHIPPLE, *Forest, Fish and Game Commissioner:*

SIR.—Everybody interested in the wild animal life of New York State, will read with increasing satisfaction the annual statistics now transmitted for your consideration. Although the hunters were far from satisfied with the conditions which prevailed, they secured a much larger number of deer than they did during the season of 1905. This result is all the more significant when it is remembered that the hunting season of 1906 was fully a month shorter than that of the previous year. An increase of 217 deer shipped out of the Adirondacks by the express companies during the past season is what the record actually shows when compared with the figures of 1905, and the records of the Commission prove that more deer were killed and shipped out last year than in any season during the past six years. These figures again prove the unreliability of the personal ideas annually expressed offhand by the hunters themselves, which this season were recorded in a dispatch, dated November 16th, which declared that "the number of deer killed this year and shipped out of the woods was considerably less than that of the season a year ago."

It may be noticed that the figures given officially show some slight decrease in the weight of heavy deer shipped out, but there is nothing in this that should cause alarm or indicate anything wrong with the deer of the Adirondacks. The heaviest deer shipped in 1905 weighed 265 pounds; the heaviest deer shipped during the past season weighed 246 pounds. The total weight of the carcasses, saddles and heads of deer taken out of the Adirondacks by the express companies during the past season, as shown by their receipt books, amounted to 212,847 pounds, or more than 106 tons.

As usual the statistics of actual weights and shipments furnished by Supt. J. L. Van Valkenburg, of the American Express Co., and Supt. C. S. Colvin, of the National Express Co., were promptly produced and were prepared in a satisfactory manner.

No epidemic of any kind has been reported, and it has been repeatedly stated that the condition of the deer killed indicated an ample food supply during the past season, as well as an excellent condition of health.

The Annual Kill

YEAR.	CARCASSES.	SADDLES.	HEADS.
1900	1,020	89	95
1901	1,062	103	121
1902	1,354	113	193
1903	1,961	145	188
1904	1,618	124	152
1905	2,196	108	180
1906	2,413	108	102

It will readily be seen from these figures, which represent actual shipments, accurately recorded by the express companies, that the increase in the number of deer killed has kept step with the increase of protection, and with the better understanding of the law and its better observance by the hunters themselves. What is much more to the point with the sportsmen is the fact that the number of deer they have been able to secure has increased steadily each year, and that during the past seven years but one season has shown a less number killed than the year preceding it. The shipments for 1906 were, as stated, more than 200 greater than the shipments for 1905, which was up to that time the record year.

The actual shipments during the past season, as reported by the express companies, showing the locations from which the deer were sent, as well as the number of saddles and heads, were as follows:

Shipments of Deer from Points in the Adirondack Region Season of 1906

MOHAWK AND MALONE RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Beaver River	136	7	9
Big Moose	44	4	
Clearwater	79	2	2
Childwold	45		
Forestport	35	2	
Fulton Chain	51	5	
Floodwood	13		
Hinckley	1		
Horseshoe	1		1
Lake Clear Junction	14	3	6
Lake Kushaqua	14		
Lake Placid	9		1
Little Rapids	1		
Long Lake West	80	4	4
Loon Lake	14	1	
Malone	8	1	10
McKeever	31		2
Minnehaha	9		
Ne-ha-sa-ne	1	1	
Onekio	3		
Otter Lake	15		
Owl's Head	2		1
Paul Smith's	19		
Piercefield	97	10	
Pleasant Lake	5		
Poland	39		
Robin Wood	1	1	7
Saranac Inn	14		
Saranac Lake	5		
Tupper Lake Junction	91	3	2
Woods Lake	14	1	
White Lake Corners	28	1	
Total	919	46	45

New York and Ottawa Railroad.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Bay Pond	1		
Brandon	15		
Chi dwold	8	1	
Derrick	57		1
Kildare	19		
Madawaski	27	2	
Meno	28		
St. Regis Falls	9		1
Santa Clara	17		
Spring Cove	13		
Tupper Lake	12	1	8
Total	206	4	10

Utica and Black River Railroad.

Alder Creek	14	1	
Barneveld	1		
Boonville	3		1
Carthage	4		
Castorland	4		
Deerfield	57		1
Lowville	10	4	
Lyons Falls	16		
Port Leyden	11		
Prospect	48		
Remsen	6	2	
Aldrich	3		
Benson Mines	54	2	
Copin Mills	1		
Emeryville	1		
Harrisville	43	1	
Kalurah	24		
Natural Bridge	3		1
Newton Falls	100	2	
Oswegatchie	27	2	1
Total	430	14	4

ROME, WATERTOWN AND OGDENSBURG RAILROAD.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Adams		1	
Antwerp	5		
Canton	15	3	
DeKalb Junction	2		
Gouverneur	1		
Potsdam	48	2	
Watertown	1		
Total	72	6	

FONDA, JOHNSTOWN AND GLOVERSVILLE RAILROAD.

Johnstown	1		
Gloversville	17	1	
Mayfield	2		
Northville	181	6	12
Total	201	7	12

LITTLE FALLS AND DOLGEVILLE RAILROAD.

Dolgeville	24	1	5

NEW YORK CENTRAL AND HUDSON RIVER RAILROAD.

Fonda	4		
Little Falls	3		
Total	7		

GOUVERNEUR AND EDWARDS RAILROAD.

Edwards	6	2	

CRANBERRY LAKE RAILROAD.

Wanakena	33		7

LOWVILLE AND BEAVER RIVER RAILROAD.

Croghan	35		1

RAQUETTE LAKE RAILWAY.

RAILROAD STATION.	CARCASSES.	SADDLES.	HEADS.
Raquette Lake	43	7	

DELAWARE AND HUDSON RAILROAD.

Bloomingdale	2		1
Crown Point	1		
Dresden	1		
Granville	2		
Greenwich			1
Hadley	2	1	1
Lake Placid	9		1
Loon Lake	6		
Lyon Mountain	2		
North Creek	225	17	3
Port Henry	22		
Riverside	21	3	4
Saranac Lake	3		
Stony Creek	134		
Ticonderoga	2		
Thurman	4		3
Warrensburg			4
Westport	2		
Total	438	21	18

RECAPITULATION.

Mohawk and Malone	918	46	45
New York and Ottawa	206	4	10
Utica and Black River	430	14	4
Rome, Watertown and Ogdensburg	72	6	
Fonda, Johnstown and Gloversville	201	7	12
Little Falls and Dolgeville	24	1	5
New York Central and Hudson River	7		
Cranberry Lake	33		7
Gouverneur and Edwards	6	2	
Lowville and Beaver River	35		1
Raquette Lake	43	7	
Delaware and Hudson	438	21	18
Total	2,413	108	102

As requested, the express companies have again recorded the actual weights of the larger deer shipped, and the record is practically as satisfactory as in former years. The locations from which these large deer were shipped are also given, so that those who are curious about the matter may make such comparisons as will show the parts of the Adirondacks from which the larger deer come year after year.

NOTABLE SHIPMENTS.

RAILROAD STATION.	CONSIGNEE.	DRESSED WEIGHTS, POUNDS.
Benson Mines	L. E. Jewell, Rochester	201
Benson Mines	A. H. Felter, Syracuse	237
Northville	B. F. Kathan, Gloversville	227
Northville	N. H. Roberts, Gloversville	218
Newton Falls	John Barnwich, Syracuse	205
Harrisville	John Hill, Rose	203
Harrisville	Louis Lenne, Watertown	205
Raquette Lake	F. E. Weeks, Herkimer	205
Brandon	C. Bump, Dickinson Center	203
Brandon	Mrs. H. N. Doll, Buffalo	201
Brandon	M. Folsome, Winthrop	210
Brandon	Mrs. Rice, Winthrop	203
Brandon	J. Birkett, Morris	240
Derrick	J. H. McClure, Tupper Lake Junction	205
Derrick	George S. Casey, Malone	212
Kildare	Joe Dibble, Owl's Head	205
Meno	W. C. Feathers, Troy	201
Meno	C. C. Hall, Ellenburg	201
Santa Clara	C. Glandorf, New York	203
Spring Cove	H. C. Bornbard, Ellenburg	205
Alder Creek	J. H. Rittersdorf, Utica	225
Glenfield	F. W. Moore, Carthage	205
Port Leyden	D. Len, Utica	246
Port Leyden	T. P. Leland, Utica	205
Forestport	A. Senton, Buffalo	205
Otter Lake	J. Gilcher, Syracuse	202
Otter Lake	O. C. Oferlanden, Syracuse	202
Floodwood	H. S. Moore, Saranac Lake	201
Floodwood	T. J. Farrell, Saranac Lake	201
McKeever	P. Burke, Fonda	205

NOTABLE SHIPMENTS — (*Continued*).

RAILROAD STATION.	CONSIGNEE.	DRESSED WEIGHT, POUNDS.
Beaver River	C. Ballou, Utica	205
Forestport	W. Cushman, Utica	209
Fulton Chain	H. Baldwin, New York	210
Lake Clear Junction	E. E. Mogg, Syracuse	220
Lake Clear Junction	Frank Bayer, Oswego	201
Lake Kushaqua	T. W. Hitts, New York	207
Lake Kushaqua	Alfred Anglin, Rockland Lake	205
Loon Lake	James Dowie, Utica	202
McKeever	Walter Springs, Remsen	217
Paul Smith's	S. E. Sully, Buffalo	210
Saranac Lake	F. Byer, Lake Clear	210
Saranac Inn	W. McDonald, Saranac Lake	205
Tupper Lake Junction	J. H. McLean, Elmira	225

Several accounts of deer weighing above the average have also been received from hunters who did not ship their deer out of the woods. Madison Tooley, a guide, got a sixteen-point buck which weighed 255 pounds dressed, and which was one of the largest deer killed during recent years in Jefferson county. This deer will be mounted and kept for exhibition.

John Farrell, of Clayburgh, Clinton county, killed a deer which weighed 215 pounds, and which he found wounded near Chazy Lake. The wounded animal attacked the hunter, who finally killed it with an axe.

A fifteen-pronged buck was shot on Peaked Mountain by George W. Aldrich, of Norwich, Chenango county. A peculiarity about this deer was the growth of an extra prong on the antlers which extended forward on each side of the head about ten inches and which were nearly horizontal in their projection when the head was carried erect. On account of the strange and unusual appearance which these prongs gave to the antlers, the head was mounted and will be kept as a highly prized specimen.

White Deer

Each year brings its reports of white or albino deer killed in the Adirondacks. Few of these are wholly white, and most of them are deer which simply have a lighter colored coat than is usual. In some cases the coat is

spotted with white only. Occasionally, however, a deer is killed whose coat is almost entirely white, and such specimens are prized highly by the fortunate hunters who secure them, and are almost invariably mounted. During the past season several reports have been received of the killing of white deer.

John Soper, of Malone, killed a yearling buck weighing ninety pounds near Ragged Mountain that was all white except a few brown spots on the head and back. This specimen was peculiar in that its under jaw was fully an inch shorter than the upper, and its feet were as large as those of an old deer, showing it to be a freak in other respects as well as in color. It had no antlers. It was mounted for the Junction Hotel at Malone.

E. C. Manzer, of Warrensburg, killed a buck near West Stony Creek which had a white coat containing a few brown and black spots. It had a good set of antlers, and was remarkable for its short legs, short neck and stubby nose, which resembled that of a sheep. It weighed 225 pounds. This animal had been seen for some time in the Harrisburg country, and bore the marks of rifle bullets. It was also mounted for exhibition.

A Black Deer

Early in December Chief Protector John B. Burnham was advised that several reliable men had seen a black deer in the northern part of Essex county. One of his informants was Supervisor J. D. Richards, of Lewis, and others were Augustus Goff and Augustus Cross, of Lewis, Charles Gay, of Reber, and Arthur Edwards, of Clintonville. The animal was seen at various times during the hunting season in the years 1903, 1904 and 1905. In the country around Mount Fay and Sugar Loaf Mountain, in the north part of the town of Lewis and the west part of the town of Wilsboro, the hunters stated that the deer was of a jet black color, and that all efforts to capture it had failed. Prof. C. Hart Merriam, Chief of the Biological Survey, when asked about the matter, wrote: "I do not remember any reference in the books to a black deer. At the same time melanism is common among mammals, and black individuals are likely to crop out now and then in any species." Col. W. F. Fox, the Superintendent of Forests, is of the opinion that the "black deer" may have been an elk, and says that the cow

elk, when two or three years old, is of a dark color and may easily be mistaken for a deer. The hunters, however, stick to their assertion that what they saw was really a black deer, and as all efforts to capture the animal seem to have failed, the incident is recorded for what it is worth.

Deer in Other States

For the purpose of showing the conditions which prevail in nearby States, inquiry was made relative to the deer hunting in Maine, New Hampshire and Vermont during the past season. Hon. L. P. Carleton, Chairman of the Commission of Inland Fisheries and Game of Maine, replied as follows : " Length of deer season, October 1st to December 15th; number of deer killed during present season, at least 20,000; heaviest weight reported, 222 pounds; proportion of does and bucks taken, about equal; number of non-resident hunting licenses issued, about 2,400."

Mr. Merrill Shurtleff, Secretary of the Fish and Game Commission of New Hampshire, stated that the length of the deer season there is from October 1st to December 1st, and that licensed hunters killed and shipped out of the State ninety-seven deer during the season of 1906. To the questions as to the heaviest weight recorded, proportion of bucks and does taken, and number of non-resident hunting licenses issued, he replied: " Do not know."

Hon. H. G. Thomas, Fish and Game Commissioner of Vermont, replied: "The length of our deer season is six days; a total of 636 deer was killed during the season. The heaviest weight reported was 415 pounds; only bucks were killed; twenty non-resident hunting licenses were issued." The alleged weight of the heaviest deer was questioned by our Superintendent of Forests, who is an expert on the subject, and Commissioner Thomas was asked if he was sure of its correctness. His reply was : " This was reported as the actual weight and not estimated. Some of the weights given us are estimated, but if they seem to be exaggerated the weight is cut down to the average. Most of the deer are weighed on scales at the request of the Commissioner. One was killed in my own town that weighed 403 pounds after the entrails were removed."

The Elk

The number of wild elk in the Adirondacks has been steadily increasing during the past five years, since the first carload of twenty-two released in June, 1901. Besides the natural increase, twenty-six elk—five bulls and twenty-one cows—have been liberated since the appearance of the last annual report. These were obtained by Harry V. Radford, of New York, from Mr. Austin Corbin, who generously donated them to the State of New York. They were brought from Mr. Corbin's Blue Mountain Forest Park, in New Hampshire, where Mr. Blaine S. Viles, Mr. Corbin's superintendent, attended to catching the elk and putting them upon the cars. Seventeen of the elk were shipped to North Creek, and from there carried upon sleighs thirty miles northwest, to Newcomb, in Essex county, where they were liberated, on State land, in two small bands about four miles apart—nine on the north of Lake Harris, and eight near Woodruff Pond. Each of the bands contained one bull, the others being cows. The expense of liberating these was paid partly by the Newcomb branch of the Adirondack Guides' Association and partly by Mr. John Anderson, Jr., of Newcomb. Mr. E. J. Chase, Vice-President of the Guides' Association, accompanied the elk from New Hampshire, and, with Game Protector Charles Barnes and Mr. Radford, attended to the details of liberation. These elk were released on March 16, 1906.

On March 22d four more of the Corbin elk were liberated on State land, in Warren county, in the "Big Hollow," on West Brook, north of Prospect Mountain, and about three miles west of the village of Lake George. The following day the remaining five were carried down the lake upon the ice, and liberated on Tongue Mountain, on the west side of the lake. Mr. Weslie W. Burton, of The Antlers, Lake George, the Lake George Fish and Game Club, and various hotelmen and cottagers residing along the lake subscribed the funds necessary for the transportation and liberation of the elk.

Most of the cow elk were pregnant when liberated, and both the Newcomb and Lake George herds have already considerably increased. About fourteen calves have been added to the Newcomb bands and six to the Lake George herds, making a total of forty-one elk in the two localities at the

present time. One elk has been shot at Newcomb, whether maliciously or accidentally has not been ascertained, though Commissioner Whipple and Mr. Radford have offered a reward of $100 for the detection of the culprit.

Meanwhile, the elk in all sections of the Adirondacks have increased satisfactorily. The large elk herds which formerly were concentrated in the vicinity of Little Tupper Lake, in Hamilton county, have split up into small bands, some of which have been seen recently on Cold river in Essex county, in the Fulton Chain section of Herkimer county, and at many other points widely separated. Game Protector Ned Ball, of Old Forge, has traced the course of three elk from Forked Lake, in northern Hamilton county, to a point south of Woodhull Lake, in Herkimer county, a distance of nearly 100 miles by the route followed, which will give an idea of the wide area over which the Adirondack elk are ranging.

A conservative estimate of the present number of elk in the Adirondacks would probably be 350. Believing that the annual increase since the experiment of restocking the Adirondacks was commenced is of general interest, the table appearing in the last report is here reproduced, revised to date:

NUMBER OF WILD ELK IN THE ADIRONDACKS.

On December 31, 1901	22
On December 31, 1902 (estimated)	80
On December 31, 1903 (estimated)	168
On December 31, 1904 (estimated)	200
On December 31, 1905 (estimated)	250
On December 31, 1906 (estimated)	350

Mr. Radford states that he has the promise of an additional herd of elk for liberation in the Adirondacks next spring. The Commission again invites sportsmen of means who are interested in the State's effort to reintroduce the elk, moose, and beaver in its Adirondack forests, to make donations of any of these animals to the Commission, which will provide for their immediate liberation on public land.

The Moose

The Legislature last spring appropriated the sum of $2,149.73 for continuing the purchase of wild moose and their liberation in the Adirondacks. This was the lapsed (unexpended) balance of the original moose appropriation of 1901. The Commission is at present negotiating for the purchase of ten of these animals.

The restocking of the Adirondacks with moose never obtained a fair impetus, as but fifteen moose were purchased with the original appropriation in 1902 and 1903, and about half of these were bulls. Several of the cows were, unfortunately, killed at the very outset of the experiment, so that it received a serious check almost at its inception. There are a few moose in the Adirondacks at present, but not a sufficient number to perpetuate the race without additions to the stock. Game Protector Ball reports one from the vicinity of Beaver River, which was seen some weeks ago.

It is believed by friends of the project that no insurmountable difficulty confronts the plan to restore the moose, and that it is merely a question of liberating a sufficient number to offset the mishaps which are always likely to occur in the early stages of an enterprise of this kind. It has been clearly demonstrated, in the case of the elk and the beaver, that wild animals native to the region can be successfully reintroduced in the Adirondacks, and as this section was until fifty years ago abundantly supplied with moose, and as the conditions affecting the subsistence of this animal are substantially the same now as they were then, there seems to be no good reason why the experiment should not be continued.

The Black Bear

The number of wild black bears killed in this State during the year ending June 30, 1906, was greater than the number killed during the preceding year. The table which follows shows the number of bears reported killed in each county. As protection is not accorded the bear in Essex county, no reports are received from that county. The returns made for bounties show, however, that fifty-two bears were killed there during 1906. In the town of Wilmington, one man, Mr. Asa Lawrence, killed thirteen. The value of the sheep killed by bears in this town alone is placed at $300.

BEARS REPORTED KILLED DURING THE YEAR ENDING JUNE 30, 1906.

COUNTY.	MALE.	FEMALE.	SEX NOT STATED.	SHOT.	TRAPPED.	METHOD OF TAKING NOT STATED.	TOTAL.
Clinton	1	. . .	. . .	. . .	. . .	1	1
Franklin	3	3	. . .	3	. . .	3	6
Fulton	2	. . .	. . .	2	. . .	. . .	2
Greene	6	4	1	4	. . .	7	11
Hamilton	13	12	4	10	2	17	29
Herkimer	7	6	1	1	1	12	14
Jefferson	. . .	. . .	1	1	. . .	. . .	1
Lewis	6	10	4	4	10	6	20
Orange	. . .	1	. . .	1	. . .	. . .	1
Oswego	. . .	1	. . .	. . .	. . .	1	1
St. Lawrence	2	4	. . .	1	. . .	5	6
Saratoga	3	. . .	. . .	2	. . .	1	3
Sullivan	. . .	1	1	1	. . .	1	2
Ulster	9	2	. . .	. . .	. . .	11	11
Warren	9	4	. . .	. . .	1	12	13
All counties	61	48	12	30	14	77	121

The following is a summary of the bears reported killed in this State since the bear law went into effect, May 9, 1904:

Reported killed, May 9, 1904, to June 30, 1904	3
Reported killed, year ending June 30, 1905	90
Reported killed, year ending June 30, 1906	121

The largest bear reported during the year ending June 30, 1906, was that killed by Mr. Charles Monroe in Sullivan county, on November 1, 1905. Its weight was 480 pounds. The smallest were the three cubs caught by Mr. John Taylor, in Lewis county, on April 4, 1906, which weighed but six pounds apiece. During this period six bears were taken weighing 400 pounds or over; twelve weighed between 300 and 400 pounds; thirty-two between

200 and 300 pounds; thirty-six between 100 and 200 pounds. Thirty-three weighed less than 100 pounds. The weights of two were not given. The average live weight of bears killed in this State has been ascertained, from the records of the past year, to be 174 pounds.

The Beaver

The beaver is rapidly increasing in numbers in the Adirondacks, and the effort to reintroduce this animal appears to be a complete success. Mr. Radford, who has visited various sections of the North Woods during the past few months for the purpose of making a census of the wild animals, estimates the present number of beavers at seventy-five. He says that ten years ago there were not more than a dozen beavers in the Adirondacks, probably less.

Only one beaver has been liberated during the past year. That was released by Mr. George A. Stevens, proprietor of the Stevens House, at Lake Placid, on a brook entering the head of the lake. Mr. Stevens expects to liberate others.

The Legislature of 1906 appropriated $1,000 for continuing the restocking of the Adirondacks with beaver; and the Commission has arranged with the Secretary of the Interior for a shipment of twenty-five from the Yellowstone Park. They will be liberated as soon as received.

The beavers released by the State in 1905 have made themselves entirely at home in their new environment. They have built dams and erected houses in several places in Hamilton and Herkimer counties, and appear to be increasing satisfactorily. A newspaper item, very generally printed toward the latter part of last May, is interesting in this connection. It stated that: "While on a tour of inspection in the Upper Saranac Lake country, Commissioner Whipple found along Fish creek, which runs into Saranac lake from Floodwood, signs of a colony of at least twelve beaver which had felled about 170 trees during the spring months.

"This demonstrates, he believes, that beaver are not only numerous but exceedingly active. Last fall the beaver colony in this locality felled ninety-six trees.

"The Commissioner also made the discovery that two trappers have

been at work in this neighborhood, and game protectors were immediately dispatched to the point to protect the beaver.

"'While the State is spending money to import wild beaver and colonize them in the North Woods,' said Mr. Whipple, 'it would be a crime to kill a single one of these animals, and if we find that they have been trapped or shot we will prosecute the offenders relentlessly. The colonies that we have planted in other parts of the Adirondacks are flourishing, and there is no reason why, before many years, the State may not be enriched by the rapid increase of these valuable fur-bearing animals.'

"The beaver along Fish creek were not some of those which have been brought into the woods, but must have been some of the few remaining natives. Commissioner Whipple caused the announcement to be made in the Saranac region that he would pay $100 in cash out of his own pocket as a reward for the conviction of any persons who might have been concerned in the slaughter of any of the beaver."

Protector Grenon, who investigated the doings of the trappers referred to in the newspaper item, reported that none of the beaver had been killed by them. He also said: "The colony is a large one and is now working further down stream. They have cut this spring about 176 trees, and they cut something less than 100 last fall on which sprouts have since started, indicating that the cutting was done before this spring. There must be from twelve to fifteen beaver in the colony. Fish creek is in a rugged, mountainous country, and formerly was a favorable section for beaver to live in."

A Gray Wolf Killed

A letter received from Edward S. Fellows, of Falconer, N. Y., stated that on November 2, 1906, while visiting at Port Byron, eleven miles north of the city of Auburn, he killed a gray timber wolf. According to his story, his dog scented the animal and after a long chase he found it at bay and killed it with a shot from a 32-calibre revolver. The specimen measured five feet from tip to tip, and it is understood that it will be mounted for exhibition. There is no explanation on the part of the old hunters in the woods as to how this stray wolf came to be where it was found. The animal has long been supposed to be extinct in this part of the country.

Hunting Licenses

In the fall of 1905 the issuing of non-resident hunting licenses was begun by the Commission, on the advice of the Attorney-General that the existing law was mandatory. The requirement was made generally known through the daily papers, and the publications appealing directly to sportsmen. The first application for a license was received from New Jersey on September 26th, and on November 1st, following, the fiftieth license was issued. The rate charged was that existing in the State from which the applicant came. The result for the past two years is shown in the following table:

ADDRESS OF APPLICANT.	LICENSES ISSUED.		RECEIPTS.	
	1905.	1906.	1905.	1906.
Connecticut	11	7	$110 00	$70 00
Delaware	1	. . .	5 00	. . .
Massachusetts	14	12	140 00	120 00
Missouri	. . .	1	. . .	15 00
New Hampshire	. . .	3	. . .	30 00
New Jersey	26	33	273 00	346 50
Ohio	2	4	30 50	61 00
Ontario	. . .	2	. . .	50 00
Pennsylvania	13	27	130 00	270 00
Vermont	2	2	30 00	30 00
	69		$718 50	
Less (cancelled)	2		20 00	
	67		$698 50	
England	. . .	2	. . .	20 00
Sweden	. . .	3	. . .	30 00
Total	67	96	$698 50	$1,042 50

Hunting Casualties—1906

Mr. W. E. Wolcott, Secretary of the Black River Fish and Game Protective Association, has kindly kept track of the hunting casualties during the past season and furnishes the following list for the Adirondack region:

October 26. Howard Johnson, Greene, aged 19, dangerously wounded by the accidental discharge of his gun while hunting at Bracket's pond.

October 27. Otto Schram, New York, while hunting in the woods near Cranberry lake, St. Lawrence county, was mistaken for a deer and shot. He died within an hour.

October 27. Harold J. Becker, Albany, aged 17, while in camp at Pitchfork lake, Franklin county, accidentally shot by a companion with a revolver. He died the next day.

November 6. Winfred E. Woodard, Newcomb, Essex county, aged 14, accidentally shot in the stomach by his own gun while out hunting. Died in a few hours.

November 8. W. H. Curry, East Pembroke, mistaken for a deer while hunting near Beaver river and shot in the left side. A critical operation saved his life.

November 14. H. J. Buell, Constable, aged 34, mistaken for a deer while hunting near Kushaqua and shot dead.

November 17. Robert Kimball, Vernon, aged 13, accidentally killed while hunting, by the discharge of his own gun.

November 17. John Driska, Little Falls, while fox hunting had his hand lacerated badly by the accidental discharge of his own gun.

November 18. Michael Creedon, Little Falls, accidentally wounded in the legs by the discharge of a gun in the hands of a companion.

The total number of hunting accidents in the Adirondacks reported in 1905 was seventeen; for the past season it was but nine.

Respectfully yours,

JOHN D. WHISH,

Albany, N. Y., December 30, 1906. *Secretary.*

Forest Management

By C. A. Schenck, Ph.D.*

THE term "forest management," used in a broad sense, comprises collectively the branches of forestry known as forest survey, forest management, forest finance and forest working plans. Used in a narrow sense, the term "forest management" deals with forest working plans only, and is usually defined as that branch of forestry which determines upon and regulates the sustained yield (la possibilité) of forests; or, by others, as a systematic arrangement of the rules by which abnormal woodlands are transformed into normal forests.

American forest management will do well to rest on a broader foundation. It should determine, in science, as well as in practice, upon the ways and means by which the desire of the owner, relative to the use of a forest (for revenue, timber supply, shelter, pasture, ornament, water protection, game preserves, etc.) can be best accomplished. In the majority of cases the owner desires to draw from the forest the largest possible revenue. As a consequence American forest management will have to deal with the various means by which given forestal investments can be developed in a manner producing the highest dividends in the long run.

In Europe financial considerations are rarely applied to forest management. Since 1871, however, the adherents of John Frederic Judeich insist

*Forester, Biltmore Estate, Biltmore, N. C.

that forest management (like farm management, railroad management and any other business management) should see its goal in a strife for the highest rate of interest obtainable from all productive capital engaged in the forest.

The owners of forests (like the owners of farms, mines, hotels, railroad stocks) cannot be expected to seek any other managerial end in the administration of their property.

The rapidity of any development depends (in forests, farms, mines, perhaps in all investments), pre-eminently on the owner's financial ability to make desirable moves at the most desirable time.

In many instances development is possible only with the help of money borrowed by the owner. Borrowed money (mortgages, bonds) usually proves a curse to the owner of forests after the lapse of a few years. His policy of development is handcuffed by the necessity of meeting the indebtedness, year in and year out, irrespective of market conditions and labor conditions. Forestry, in such cases, must be destructive. It must pay the bonds as they mature out of the substance of the forest.

Frequently forest destruction promises better dividends than forest maintenance. In such cases a forest working plan resolves itself into a plan covering the various operations commonly known as destructive lumbering. The soil may be cleared because it is thought to be valuable as farm soil, pasture soil, orchard soil; or the land may be abandoned after lumbering as worthless when the owner believes that the taxes due on the cleared land (taken together with the expenses of protecting a second growth expectable on the cleared land) form a new investment of an unpromising nature.

Forests cannot be well developed where the development of the whole country is in arrears. Here the owner is compelled to adopt a policy of waiting — waiting for that general development of the country which is sure permanently to improve the value of stumpage. In such cases a working plan resolves itself into a plan for forest protection (against squatters, fires, etc.).

In the prairies, and also in the East, the land owner is frequently inclined — on a small scale, usually — to improve the condition of his property silviculturally, making investments for afforestation, cleaning,

weeding, etc. In such cases a forest working plan resolves itself, essentially, into a plan covering various sylvicultural operations (constructive forestry).

In Germany and France, at the time being, conservative forestry produces invariably financial results superior to those of de-forestation and of abandonment of cut over woodland. In these countries cut over woodland unfit for the plow (known as absolute forest land), has a value usually exceeding $10 per acre.

Modern European foresters are in the habit of identifying the term "management" with the term "conservative management" of forests; and all European forest working plans provide for conservative working of the forest.

The Ideal Forest

In an ideal forest continuously supplying certain mills or certain markets with an equal annual amount of timber or wood there should be at hand:

A normal gradation of the age classes;
A normal growing stock;
A normal increment.

No forest ever has been, is, or ever will be "ideal." The ideal forest deserves attention only in theory. Its theory deals with volumes instead of dealing with values.

Normal Gradation of Age Classes

A normal gradation of age classes is literally at hand in the forest where there are found as many age classes as the rotation comprises years. Each class has an age differing from that of any other class. The youngest class is one year old; the next class is two years old; the third class is three years old, and so on to the oldest class the age of which equals the rotation.

In the case of natural seed regeneration, the normal number of age classes at hand is expressed by the fraction

$$\frac{r}{s}$$

wherein r stands for rotation, and wherein s stands for the number of years

normally elapsing between successive seed years. Since a single seed year is rarely sufficient to secure a complete stand of seedlings, a wood raised by natural seed regeneration is usually composed of two, three or more age classes appearing in mixture and forming distinct aggregates.

Where the rotation comprises 100 years, and where the period of regeneration comprises twenty years, and where seed years occur every five years, there a "normal gradation of age classes" contains, in the fall succeeding a seed year, the following aggregate of age classes:

Youngest aggregate	1	6	11	and 16 years old
Second "	21	26	31	" 36 " "
Third "	41	46	51	" 56 " "
Fourth "	61	66	71	" 76 " "
Oldest "	81	86	91	" 96 " "

Or the following aggregates:

Youngest aggregate	6	11	16	and 21 years old
Second "	26	31	36	" 41 " "
Third "	46	51	56	" 61 " "
Fourth "	66	71	76	" 81 " "
Oldest "	86	91	96	" 101 " "

Or the following aggregates:

Youngest aggregate	11	16	21	and 26 years old
Second "	31	36	41	" 46 " "
Third "	51	56	61	" 66 " "
Fourth "	71	76	81	" 86 " "
Oldest "	91	96	101	" 106 " "

Or the following aggregates:

Youngest aggregate	16	21	26	and 31 years old
Second "	36	41	46	" 51 " "
Third "	56	61	66	" 71 " "
Fourth "	76	81	86	" 91 " "
Oldest "	96	101	106	" lacking

Amongst all age classes under twenty-one years old, some mother trees are still at hand up to 110 years old; and beneath all age classes over ninety years old, some seedlings are found up to twenty years old.

In the ideal selection forest, all age classes are represented on every acre of ground.

The separation of the age classes (allotting to each age class separate areas) facilitates logging and transportation; it increases, on the other hand, the dangers threatening the forests.

If a proper gradation of age classes exists in a forest it does not necessarily follow that the age classes are properly grouped and arranged in "cutting series." By "proper cutting series" is understood a number of adjoining age classes, sloping roof-like from the older to the younger, toward the windward side. If the cutting series are improper, then sacrifices must be made, hypermature wood must be left, and immature wood must be cut unless the mistake originally at hand is allowed to be perpetuated. In the latter case, the losses of the future are apt to be greater than the sacrifices voluntarily made with a view to the establishment of proper cutting series. Cutting series must be isolated one from the other, if need be, by "severance cuttings."

Normal Growing Stock

The normal growing stock is at hand where the age gradation of the various woods composing the forest and their respective volumes are normal. A forest, however, might have the normal volume without having the normal age gradation, when a deficiency of one age class is offset by a surplus in another age class. The normal growing stock, during summer, has the volume

$$\frac{r^2 \times i}{2}$$

wherein r represents the rotation, and i the average annual increment of a mature age class.

Illustration: A spruce forest covers 2,000 acres. The rotation is 100 years. The mature wood, 100 years old, contains normally 120 cords per acre. Under these conditions, the area of an age class is twenty acres; the average annual increment of the mature age class is twenty-four cords; and the normal growing stock is

$$\frac{100 \times 100 \times 24}{2} = 120{,}000 \text{ cords.}$$

The volume of poles and trees predestined to be cut and removed prior to

maturity (by way of thinnings) is not included in the volume given by the formula.

Whilst one normal growing stock is removed, in the course of a rotation, another normal growing stock — its exact counterpart — is raised on the very same area.

If the original growing stock is abnormally deficient, the foresters, by cutting less than the increment of the forest and thus adding to the original volume, may succeed in gradually establishing the "normal growing stock."

Normality of the growing stock is that condition required in an "ideal forest," which the foresters would find it rather easy to provide. In the virgin woods, frequently the actual growing stock is larger than the normal growing stock, owing to the preponderance of mature and hypermature age classes.

Normal Increment

The normal wood at the age of maturity has imbedded in itself the increments of a wood, one, two, three, etc., years old; consequently, it represents all of the increments taking place annually over the entire area of a normal forest containing the age classes, one, two, three, etc. Since only a few trees, however, reach maturity a rule fails to be entirely correct which reads: "The normal increment of a forest equals the normal volume of its oldest age class."

Generally speaking, since the same causes must have the same effect, the actual increment, in tons of wood fibre, normally formed on an acre of ground, fully stocked, depends solely on climate and soil, wood fibre being "solidified atmosphere." The forester's aim should be to concentrate the increment into the smallest number of trees, without losing any increment, so as to grow the biggest logs in the shortest rotation.

In America, soil is cheap; hence there seems to be no need to force every square inch of soil into the harness of tree production. We should keep in mind, however,—

1. That woods poorly stocked are apt to yield knotty timber;
2. That the outlay for taxes, protection and administration depends more on area than on density of stand;

BILTMORE FOREST, NORTH CAROLINA.

YELLOW PINE, MIXED WITH HARDWOODS, 20 YEARS OLD; NATURAL GROWTH FROM SELF-SOWN SEED, BENEATH AN OVER-WOOD OF CROOKED, DISEASED BLACK OAKS AND SPANISH OAKS. THESE OAKS WERE REMOVED AND CUT INTO FIREWOOD, YIELDING 22 CORDS PER ACRE AT $1.70 PER CORD. PHOTOGRAPH SHOWS CAREFUL MANNER IN WHICH THE OVER-WOOD WAS REMOVED WITHOUT INJURY TO UNDERGROWTH OF YELLOW PINES.

3. That the logging expenses per 1,000 feet b. m., are small where the stumpage is heavy;
4. That investments for roads and other permanent improvements, per 1,000 feet b. m., are relatively small in well stocked forests;
5. That the fertility of forest soil suffers under a loose canopy overhead.

The main sylvicultural measures leading to a normal increment are:

Weeding.
Improvement cutting.
Thinning.
Afforestation.
Reinforcing.

Financial Considerations

Three kinds of increment compose the latent gross revenue obtainable from any wood which is left to itself or which is placed under forestal care:

1. The quantity increment, depending solely on the amount of wood fibre formed.

2. The quality increment, depending solely on the difference of price shown in the same year by logs of different diameters, per unit of contents.

3. The price increment, depending solely on the difference of value which the same log will exhibit in different years. This latter increment is influenced by increase of population and wealth, cheapened facilities of transportation, exhaustion of the virgin woods, and declining purchasing power of gold.

As an illustration of price increment, the following figures may be of interest:

WHOLESALE PRICE OF YELLOW POPLAR, 4–4 LUMBER, AT BILTMORE, N. C

QUALITY.	IN 1896.	IN 1907.
*f.a.s.	$21 00	$43 00–$5200
saps.	16 00	33 00
C. 1	12 00	28 00
C. 2	6 50	16 00

*An abbreviation for "firsts and seconds."

The expense of production, with modern mills and improved transportation, is as high in 1907 as it was in 1896, viz.: $9 per 1,000 feet b. m. Assuming that certain trees have turned out 25 per cent. of fas, 25 per cent. saps, 25 per cent. C. 1 and 25 per cent. C. 2, the stumpage values of such trees was per 1,000 feet b. m.

In 1896	$5 00
In 1907	22 00

and has increased, consequently, at the rate of 30 per cent. (simple interest, equalling 14 per cent. of compound interest) per annum.

The increase in the value of many other forest products has been similarly phenomenal; and the question arises: Why is the owner of forests unwise enough to reduce this stumpage as long as the rise continues to be phenomenal,— in excess of any dividend derivable from other investments? The answer frequently lies in three words:

Poverty;
Impatience;
Ignorance.

The enormous increase of gold production during the last 20 yeasr promises to continue and to become more phenomenal. The director of the U. S. Mint reports (in 1904, p. 41) that the rise of wages does not act as an automatic check to gold production, and that the tendency of the expense of gold production continues to be downward. The effect of increasing gold supplies on commodity prices, wages, land values, mortgages, bonds, etc., is easily perceived:

The owner of bonds and mortgages sinks to a lower level of revenue; whilst the owner of forests and farms remains (at least) equally wealthy.

The question will be asked naturally: Does it pay to strive towards the establishment of an "ideal forest" — towards the establishment of an impossibility?

European foresters are apt to answer the question by an emphatic "Yes."

The American forester might consider, before answering, four points:

(1) The great variety of conditions existing in the various sections of the various states from which the financial prospects of conservative forestry depend.

(2) The fact that conservatism in the forest cannot be expected, in the long run, to be as remunerative in this country as it is abroad unless the forest is rendered as safe as the German forests from fire, taxes and whimsical legislation.

(3) The fact that an ideal forest represents a large investment yielding a small rate of surplus revenue.

(4) The possibility that a forest now considered " ideal " as to rotation, composition, species, roads and so on, is apt to be considered deficient when the lapse of years has caused a change of the economical conditions surrounding the forest.

As long as our country develops by leaps and bounds, as long as the immediate future of our forests is dark, as long as other investments seem safer, simpler, better than forestal investments, the time has not arrived to strive toward " ideal forests."

The American forester can consider the forest only as " so much money invested." That forest is ideal which can be expected to yield, for a long time and perhaps forever, a safe, steady and high dividend on every dollar invested. In such a forest, the various items of value (as trees, soil, roads, sawmills) appear as proper shares of the aggregate value.

The following may serve as an illustration:

Value of stumpage, per acre	$7.75, or 77½ per cent.
Value of soil, per acre	1.00, or 10 per cent.
Value of roads, per acre	.50, or 5 per cent.
Value of sawmills, per acre	.75, or 7½ per cent.
Total investment	$10.00, or 100 per cent.

The form of the ideal revenue depends on the owner's wish. The owner may or may not prefer an annual revenue of 40 cents per acre, obtained without decreasing the value of the stumpage, to a revenue of $2.00, exhausting the forest in a dozen years. The owner alone can decide whether a dividend is safe enough, steady enough and high enough; his decision is

based, naturally, on a comparison between forest revenue and revenues obtainable from other investments.

The investor stakes his money on that enterprise in which he has the greatest confidence; and it is usual that the farmer puts his money in farms; the miner in mines; the railroad man in railroad stock; and the lumberman in forests.

The American lumberman is apt to consider investments in forestry (be it destructive or conservative) as ideal investments; outsiders are not prone to share his view.

As long as this country abounds in merchantable woods, the lumberman has an easy chance, after exhausting the stumpage on a given tract completely, to shift his capital to another tract, purchasing the stumpage thereon out of the moneys obtained by his operations conducted on the preceding tract. Usually, he prefers, for obvious reasons, the purchase of timber to the purchase of the forest in fee simple. Under such conditions, the lumberman cannot be interested in the production of second growth, nor in operations merely withdrawing trees working at a small rate of revenue.

The owners of the fee simple — farmers, townsfolks, aliens — do not command any knowledge of forest investments; having paid the taxes on the land for a number of years without any returns, they embrace readily the first chance at obtaining "big returns." These big returns usually exceed the price by far at which the land was bought. Nevertheless, and just as usually, such "big returns" are a mere pittance.

The Forest Service of the United States has before it an enormous task: the task of proving to the owners of woodlands, who are ignorant of present and of prospective values of timber, the advisability of conservative lumbering.

Unfortunately, there do not exist anywhere associations of forest owners through which the members might be enlightened.

Sustained Yield ("Possibility")

Normally, the "sustained yield" of the forest is that number of cubic feet of wood which nature produces in the forest annually; the annual

removal of this number of cubic feet does not decrease the original amount of stumpage. The normal sustained yield equals the annual surplusage of production.

The cutting of a sustained yield — no more, no less — is indicated wherever the capacity of the market is limited, a condition which we meet almost invariably on the fuel market. In Germany, two-thirds of the annual increment of all forests consists of fuel wood. In America, the requirements of expensive, non-movable plants (tanneries, pulp mills, mines) are in the direction of a sustained yield.

When all merchantable trees have been removed from a forest, a sustained yield cannot be obtained any more. Before touching the primeval forest, the owner must decide whether or not conservative forestry, whether or not a sustained yield is indicated.

Primeval woods containing a large number of idling and decaying trees should not be worked for a sustained yield.

It should never be forgotten that there is a vast difference between the term "merchantable trees," and the term "mature trees." Merchantable trees are very often far from being mature; and mature trees have often ceased to be, or are not, merchantable.

An equal annual yield offers to the lumberjack the advantage of equal and steady employment in one and the same forest or at one and the same mill.

An equal annual yield offers to the owner approximately equal annual dividends.

Where no yield is obtainable for a long series of years, there the outlay for taxes, protection and administration will accumulate at a rate deterring the owner from any attempt at conservatism.

The disadvantages of a sustained yield where it binds the forester in iron chains, are:

1. It is impossible to take advantage of boom prices.

2. It is necessary to cut in years of panic.

3. Trees without increment are left uncut; trees of good increment are cut where the yield is strictly sustained. Similarly, needful thinnings are often postponed; or in other cases, conducted with excessive severity.

4. Valuable young growth is often left under severe pressure overhead or in other cases prematurely exposed.

5. Seed years are not used to full advantage.

The normal possibility, from the economic standpoint, cannot be expressed by volume; it must be expressed in dollars and cents. It is that sum of money which yields annually the expected or desired interest on all capitals engaged in the forestal production. In other words, it is the yield of a forest when in financial equilibrium. In that case, no wood works at a lesser rate than at the proper indicating percentage adequate to its age.

The ratio between annual cut and stumpage at hand reads, in the normal forest:

$$\frac{\text{sustained yield}}{\text{normal growing stock}} = \frac{r\ i}{\frac{r^2\ i}{2}} = \frac{2}{r}.$$ The factor $\frac{2}{r}$

is called the utilization percentage. It expresses the fact that a short rotation allows, when the growing stock is given, of a larger possibility than a long rotation. Short rotations are handicapped by silvicultural drawbacks and the production of small trees only, the demand for which is restricted (firewood, spokes, axe-handles and railroad ties). The utilization percentage, since it is the ratio of volumes only, has little economic importance.

Subdivisions of a Forest

The subdivision of a forest into minor units of management is based on local conditions and on local needs.

A large forest is usually subdivided into

Working circles,
Working sections,
Compartments and blocks.

BILTMORE FOREST, NORTH CAROLINA.

IMPROVEMENT CUTTINGS AND REMOVAL OF HARDWOODS THEREBY PROMOTING THE GROWTH OF YELLOW POPLAR OR WHITEWOOD SAPLINGS (LIRIODENDRON TULIPIFERA).

Working Circles

Under "working circles" we understand, after Schlich, that forest area owned by one person or company which is largely under the provision of one and the same working plan.

Working Sections

In large working circles, the economic conditions are frequently such as not to allow of uniting all woods under one cutting plan. Woods growing under more or less equal conditions and exhibiting equal silvics are allotted to distinct working sections, to be dealt with independently from all others. A working section should comprise woods of all ages and classes, and should consist of several cutting series. There is no need for the working section to cover a coherent area. For each working section in Europe, the financial possibility is ascertained separately. The following moments may necessitate the formation of a working section:

1. Different species.
2. Different silvicultural requirements.
3. Different rotation.
4. Different laws.
5. Different means of transportation.
6. Different locality.

A large number of working sections complicates forest administration.

Compartments and Blocks

The leading foresters do not agree with regard to a proper definition of the term "compartment." For the majority of foresters, a compartment is a "unit of silvicultural treatment." The compartment may contain subcompartments consisting of smaller or larger groups which, to speak with the advocates of that definition, should be eliminated by purification of the compartments. Others maintain that the compartment should designate merely a geographical unit of the forest used to describe,

in instructions, reports and records, the exact locality at which a certain act is to be or has been performed.

The boundary lines of geographic compartments should be natural ines (ridges, creeks and slopes) as much as possible, and not artificial lines (survey lanes and roads). The size of the compartment depends entirely on local economic conditions. High timber prices and intensive management invite the formation of small compartments.

Several adjoining compartments are allotted to a "block;" for instance, the compartments on a certain mountain or beyond a certain creek. In some cases, each block has a separate series of compartment numbers, each series beginning with "one." A block may be composed of compartments belonging to different working sections.

Under extensive management, a block might be formed by the area drained by an entire river system; and the compartments composing it might be designated by the names of the creeks traversing them.

Working Plan Reports

The term "working plan" is a misnomer. The "working plan" is a report more on facts than on proposed schemes.

The meaning of the term is somewhat indistinct. It might represent one or the other of the three following statements:

1. The chief (principal) working plan, extending over a large number of years (a whole rotation, or the time of installation).

2. The periodic working plan, extending over 10, 20 or 24 years usually.

3. The annual working plan, forming a mere annual budget.

In many cases, the principal working plan is simultaneously used as a periodic working plan.

The Chief Working Plan

The chief working plan is called by Schlich, more properly, "chief working plan report," and contains the following three parts:

1. A statement of facts based on stock taking.

2. The desire of the owner regarding the purpose of forest management.

3. The plan proper, containing the forester's advice as submitted to the owner, discussed with the owner and approved by the owner.

The plan proper is, usually, a compromise between owner and forester.

The chief working plan requires revision and is invariably redrawn before the lapse of many years whenever the facts are altered on which the plan was based.

The subheads of a chief working plan are:

Forest survey.
Description of locality.
Yield tables and volume tables.
Problems of silviculture and of protection.
Forest utilization.
Forestal investments.

All data ascertained and all changes planned should be shown, if possible, on maps allowing of rapid reference.

The scale and the detail of the maps depend on the value of the investment per acre.

Forest Survey

The objects of a forest survey are:

1. Outside boundaries and those of interior holdings.
2. Railroads, rivers, creeks, bluffs and other obstacles, and means of transportation.
3. Lines between localities having different laws, inasmuch as they influence forest management.
4. Differences in ownership.
5. Boundaries of the various forest ranges.
6. Configuration.
7. Differences of soil; mineral possibilities.
8. Dividing lines between forest soil, farm soil, pasture soil, and mineral soil.
9. Lines of working circles, if there are any.
10. Roads, trails and fire-lanes.
11. Age, species, and quality of growing stock, according to compartments.

It is not necessary, of course, that all of these points should be exhibited in all working plants.

Description of Locality

The "locality" is usually described by compartments. The "quality of the locality," which means to say its productiveness, is a function of soil and climate.

The height growth of the trees yields the best indication of the quality of the locality. The number of qualities of locality distinguished in a chief working plan depends on local conditions, notably on the intensity of management.

Yield Tables and Volume Tables

Yield tables are required for a forecast of future timber crops. In America, tree growth tables (volume tables) must frequently take the place of yield tables.

Yield tables and volume tables show the interdependence between soil, age, diameter and volume. It is wise to show the development of the value of a tree as well, with a view of determing the age of maturity. A tree is mature when the annual quantity, quality and price increment ceases to yield a sufficient rate of interest on the stumpage value of the tree.

Problems of Silviculture and of Protection

Wherever local conditions allow of it, the chief working plan dwells at length upon the silvicultural system to be adopted for the various working sections. The method of regeneration, the species to be favored, the extent of improvement cuttings, the method of weeding and the financial effect of these measures must be shown. The extent and advisability of forest pasture, turpentine or sugar industry, game preservation, landscape considerations, etc., must be touched.

Silvicultural investments are unwise where the forest cannot be protected from fires. The financial outlook of investments in first growth is

better than the financial outlook of investments in second growth wheresoever the restriction and the control of fires is difficult.

The chief working plan describes the existing and the proposed means of protection from forest fires, detailing the outlay to be incurred on that score.

Continuous employment of workmen in all parts of the forest, year in and year out, together with ready access to all parts of the forest, are the surest means of fire protection.

Forest Utilization

For many a year to come, the major part of the work to be planned and to be done by the American forester must consist in the utilization of the forest (lumbering). The forester is essentially a lumberman.

The working plan considers the most advisable way of transforming into money the various raw products of the forest. It discusses the financial effect of the various methods of logging (animal power versus steam power), of the various mills (portable, circular, band, etc.).

The degree in which the owner (through the forester) attends to the removal and to the refinement of his timber products is controlled by local as well as by personal conditions. The owner might offer for sale stumpage, or logs yarded, or rough lumber, or refined lumber.

As long as there are more owners of timber land than manufacturers of lumber, the stumpage market is a buyer's market; and the owner of forests does well to engage in manufacturing enterprises.

Of the utmost importance is a careful study of the means of transportation (water, rail, flumes, etc.). The forester should never forget that lumbering — and consequently forestry — is essentially a problem of transportation.

The expense to be incurred for permanent and for temporary means of transportation requires careful discussion. In conservative forestry, the main arteries of transportation, necessarily, have a permanent character. The combination of the means of transportation to be adopted (railroads, narrow or standard; cables; watercourses; flumes; wagon-roads) depends on local circumstances. Public roads and railroads, advisable alterations,

charters to be secured from the legislature, are topics requiring attention. The plan of transportation is explained by a map showing the existing and the proposed lines of transportation.

Forestal Investments

In the United States, no private activity having the forest for its object (*id est*, any forestry in a broad sense) is conceivable which does not mean to result in good financial returns. Forestry is business, and in business there is no room for sentiment. That forestry must be considered best, which pays best.

Compared with other investments in realties (e. g., farms, mines, houses), forest investments show several undesirable features. They are difficult of control; they fail continuously to yield annual cash dividends; they are endangered by fires and cannot be insured against destruction; their products are not as absolutely indispensable to mankind as farm products, mine products or the shelter of a house; subdivision, joint ownership, sale in fee are difficult to arrange; mortgages or bonds on forests are hard to secure, and theft of timber is hard to prevent.

There are, on the other hand, many factors speaking in favor of forest investments: Notably the phenomenal increase in the value of timber brought about by an increase in population and continuous prosperity; the certainty of wood production, year in and year out, with which fires only can interfere; the strong possibility of more extended use of wood products in the manufacture of paper, packages, yarns, alcohol, sugar and food stuffs; the fact that the forest stores its own products away, free of charge, until it may please the owner to place them on the market; the rapid advance in the value of soil, etc.

According to the location of the forest and in a higher degree, according to species of trees and age of trees, the disadvantages connected with forest investments vary from case to case. They seem to weigh heavily on a second growth which yields no dividend whatever, is seriously endangered by fire, contains assets of prospective value only and offers no chance at extraordinary results. There exist in the United States enormous areas

BILTMORE FOREST, NORTH CAROLINA.

COPPICE UNDER-STANDARD CUTTING, YIELDING 25 CORDS OF HARDWOOD PER ACRE, AND FOSTERING A GROWTH OF WIND-SOWN SEEDLINGS OF YELLOW PINE AND BEST OF THE REMAINING WHITE OAKS.

covered with second growth forests: What sense can there be, consequently, in investments tending to produce still more second growth?

It is obvious that the chances of first growth to be remunerative are, generally speaking, very good. This first growth does not increase in volume, the death rate of timber offsetting the birth rate; its increase in value, however, is certain; heavy logs are getting scarce,—and they alone furnish lumber commanding the highest price; the degree to which the trees are utilized without waste increases from year to year; the difficulties of transportation are declining continuously. Is it to be wondered at, then, that many investors—and notably all lumbermen—are eager to invest in first growth whilst utterly unwilling to stake their money on second growth?

The question might be asked: Why are the owners reluctant to practice "conservative lumbering," a modus of logging which tends to secure the maximum sum total formed of net present returns and prospective values left? To take an illustration from the South: Why does the owner insist on cutting every pine making a log of over six inches at the small end? Why does he refuse to leave all trees having a diameter under twenty inches and yielding over seven per cent. of latent annual interest?

The explanation lies in the following points:

1. No seer can actually foretell the latent annual interest which trees of various diameters will yield in the immediate and in the more distant future. The forest dividend consists largely of price increment; the price increment of big trees is (veneer business!) particularly good. There is little financial advantage in the utilization of big trees (if they are sound), as long as an annual price increment of ten per cent. and more can be counted upon. A big tree having a stumpage value of $12 per 1,000 feet b. m. is not mature, *per se*. The fine poplars, oaks and chestnuts of the Southland must be considered immature, since their value is absolutely sure to increase at an annual rate of over ten per cent.

The assumption of the principle is wrong, it seems, that conservative lumbering should leave the smaller trees and remove the big trees; or that maturity can be determined by diameter limits.

The owner of woodlands (and the forester) can only venture a forecast,

guessing at the future condition of the lumber market; big trees have—to say the least—the same chance with small trees to be money makers. And it is natural that the owner is inclined to either remove or to leave all of his trees.

2. Let us suppose that the owner has left in the course of lumbering all trees under eighteen inches in diameter representing a stumpage of 1,500 feet per acre. The reduction of the cut by 1,500 feet per acre has increased the logging expense per 1,000 feet of stumpage removed,—an increase which can be considered only as a new investment added to the value of 1,500 feet per acre left.

For a number of years to come, the small trees are nonremovable, since it cannot pay in the near future to remove a handful of inferior lumber from an acre of ground. In the meantime, the property must be watched and taxes must be paid.

The owner leaving small trees embarks in a new venture which cannot be countermanded nor altered, for years to come, without serious loss; and which is subject to more serious dangers than the old venture.

Small trees form, prior to the removal of the big trees mixed with them, a tangible, merchantable asset. After the removal of the big trees, however, they can be considered only as an intangible asset, an asset of merely prospective value, an asset impossible to realize on.

3. After lumbering, small trees left are much more endangered by fire, windfall, insects, fungi than before lumbering. Where fires cannot be controlled at a reasonable expense, conservative lumbering is, under almost any circumstances, absolutely absurd.

4. The soil on which small trees are left,—in order to grow into better dimensions and in order to act as seed trees for a third growth,—cannot be used for pasture without interference with the object at stake.

5. Conditions may arise, before a second growth of small trees becomes merchantable, rendering the soil occupied by them valuable for farming purposes. In that case the small trees must be removed without any benefits accruing to the owner from such removal.

6. The taxes on land completely stripped are lower than the taxes on land conservatively lumbered. When a long number of years is required to convert a second growth left into a merchantable stand, the taxes annu-

ally paid "*ad valorem*" and increasing at a compound ratio, form a countercharge against the slowly increasing value of the second growth difficult to countenance.

Considering these various points, the financier cannot be called unwise when he prefers investments in first growth forest to those possible in second growth.

Many a man in the United States and in Canada has made a fortune by clever investments in first growth, whilst no one, practically, has had a chance to show dividends obtained from second growth forest (exceptions: farm wood lots; second growth pine in Virginia).

Under what conditions, it may be asked, can or does conservative lumbering pay in primeval woods?

The conditions are those under which any business proves to be remunerative,—be it a livery business or a hotel, a railroad or a music store: that business alone can be remunerative in which the parts composing the business investments are at hand in proper proportions; that business alone can be remunerative which is established in an economically proper site; that business alone can be remunerative, which is safe from over-taxation and—by insurance or otherwise—safe from accidental destruction of its assets.

Let us take the livery business for an illustration: The investment consists of several components, viz.: horses, carriages, harness, saddles, buildings, feed. These components must be at hand in proper proportion. It would be preposterous, for a livery, to have invested, e. g.,

in horses	$1,000
in carriages	25,000
in harness	100
in saddles	50
in buildings	350
in feed	15,000

Again, the proper economic site for a livery business is in the city, the village—not in the back woods of Maine; not in the wild swamps of Minnesota; not indeed in Chicago 100 years ago; which shows the dependence of economic sites on economic development. Finally, a livery busi-

ness is never overtaxed, and all of its investments allow of being insured. There is, probably, many a livery in the United States whose owner is "falling behind,"—usually because his investments are wrongly balanced or because the site of his business is wrongly selected. Still, it would be wrong to conclude that a livery business is generally a poor business.

Properly arranged within, properly arranged without; properly insured against accidents a business must be remunerative.

Applying this logic to conservative lumbering as a business it is safe to state that it must be remunerative.

A. Where its components are properly balanced.

B. Where an economic site is obtainable for its conduct.

ad. A: The components of a business investment in conservative forestry are partly derived from nature (natural gifts, natural powers) and partly made by man. The natural components are usually at hand in primeval forests,—which does not mean to say that they are at hand in proper amounts. The components made by man are added to those made by nature and consist, above all, in investments permanently employed for forest utilization.

Thus the aggregate investments in conservative forestry may consist of all of the following components—whilst only No. 1, No. 2, No. 8, No. 11 and No. 12 are considered essential:

(a) Natural components:

1. Soil.
2. Trees.
3. Fish and game.
4. Minerals.
5. Water power.

(b) Semi-natural components:

6. Pastures.
7. Farms and orchards.

(c) Artificial components:

8. Permanent means of transportation.
9. Logging appliances.
10. Industrial establishments.
11. Means to prevent and to subdue forest fires.

12. Surveys, maps, working plans.
13. Ranger houses, workmen's houses, lumber camps.
14. Nurseries.
15. Silvicultural improvements.
16. Capital set aside to defray taxes, protection, administration and other current expenses.

In the case of well-stocked virgin woods, the aggregate final investment is likely to be lower than the original purchase price of the forest, when the virgin forest contains a surplus of mature timber exceeding in value the expense required for the establishment of the essential artificial components.

In the American forests, after the usual lumbering operations, very little is left of the natural components; as a consequence, relatively heavy additional investments are required (as a rule without a chance of deriving immediate revenue) in order to make the aggregate, in time to come, a permanent source of revenue.

The conclusion is simple: Unless the owner, before he begins to operate primeval woods, decides to embark in conservative forestry, the chances are slim that he will ever embark in it.

In German working plans the necessity of ascertaining the most opportune amount of capital to be invested in forestry is invariably overlooked. The explanation lies in the following:

1. The value of the growing timber and of the soil comprises, say ninety-five per cent. of the investments.

2. The means of transportation are already at hand, developed at a time at which financial considerations were not made in forestry.

The "period of installation" should cover as many years as are required to obtain the proper total and the proper composition of the forestal investment.

It is unfortunate that the period of installation in conservative forestry must comprise a number of years; whilst other investments (e. g., a livery) can be fully installed in the course of a few weeks or a few months.

ad. B: Whosoever has traveled in recent years through Germany with an eye to the forest cannot be in doubt that every state and every county offers innumerable sites at which conservative forestry can be conducted as a remunerative business. Indeed, economic sites are at hand in Germany wheresoever the trees do not happen to occupy farming soil.

Such was not the case in Germany 200 years ago; and such is not the case in Russia, Canada and the United States today.

Economic sites are those where stumpage values range high; where natural reproduction is easy; where the danger of fires is small; where the land is unfit for agriculture; where forest taxes are low.

These conditions prevail, particularly, in the pineries of the Coastal Plains and in the hardwood forests of the higher Appalachian region.

It must be clearly understood that these conditions did not —or did not all—prevail some twenty years ago; further, that the absence of such conditions in the West anno 1907, does not render conservative forestry in the West for all times impossible.

It is unfortunate, indeed, that the majority of these conditions arises only at a very late hour, to wit, invariably after the general disappearance of the primeval woods.

No man in the United States has had, so far, sufficient confidence in conservative lumbering to postpone the tapping of his primeval woods until the "economic site" for conservative lumbering had locally arisen.

The man who does will never live to regret his confidence.

Methods Regulating the Yield in Wood and Timber

The question as to the amount of timber which might be removed annually without reducing the growing stock (the main investment) has occupied the minds of foresters since many centuries. European governments prescribe definite methods by which the yield of a forest is to be regulated. The family laws governing entailed property do likewise.

BILTMORE FOREST, NORTH CAROLINA.

COPPICE SYSTEM, ON COMPARTMENT 24, SHOWING GROWTH OF SPROUTS FROM STUMPS IN ONE YEAR.

For America, at the present moment, these methods will find application in rare cases only. A sustained yield in virgin forests containing large numbers of idling trees is an economic absurdity. Pulp mills, tanneries, and other industrial establishments requiring large investments to be made close to a forest may, however, seek for sustained yields on cut over lands, from which the idling trees have been removed.

General Remarks

The methods commonly used for regulating the "possibility" of the forest are:

A. Brick masonry methods.
   1. Area method.
   2. Volume method.

B. Formula methods.
   3. Charles Heyer method.
   4. Hundeshagen method.

C. Increment methods.
   5. Common increment method.
   6. Brandis method.

These six methods consider the forest as a whole, ascertain the productive capacity of the whole, and locate the annual cuttings thereafter.

The methods to be considered in the following pages treat every part of the forest according to its individual financial merits, thus locating the cuttings to begin with. Thereafter, they merely see to it, if necessary, that the total cuttings of a year agree with the consuming capacity of the market.

Area Method

The simplest way to regulate the yield by area is a division of the entire forest area into as many lots as the rotation numbers years. This scheme has been followed often in the case of coppice forests having rotations less than forty years. In the case of high forests, the rotation is divided into a number of periods of equal length (ten to twenty-four years). On the "Statement of Ages" the acreage of each compartment is allotted to that periodical column to which it belongs according to its present age.

The oldest compartments are allotted to period number one; the next oldest to period number two, etc. The total acreage allotted to each periodical column is found by addition and compared with the average contents of a column. If a column contains too much acreage, the surplus is shifted backward or forward into adjoining columns. Compartments growing vigorously are shifted backward into later periods and vice versa. After shifting, each column contains in toto, approximately, an equal number of acres.

By valuation surveys or yield tables, the volume contents of the compartments allotted to the first period are ascertained; and the contents are increased by the probable volume increment of these compartments expected during half a period. The total contents are then divided by the number of years comprised by the period. The result is the annual "sustained yield." Obviously, the sustained yield is apt to change at the end of each period.

The installation period comprises a whole rotation. At the end of a rotation the forest is sure to exhibit a more normal age gradation.

This method is in use in Prussia, Bavaria, etc., and has been working in almost all European forests since 1780. The method is not applicable to selection forests. It might be improved by replacing the "Statement of Ages" by a "Statement of Indicating Percentages."

Volume Method

A statement of ages is prepared, each compartment being allotted to a periodical column according to the number of years which separates it from maturity. The compartmental entries made in the statement of ages are, in this case, however, the final volumes expected at maturity, and not the compartmental acreages.

The totals for each period are drawn and compared with the average volume expected from each periodical column. Again, by shifting compartments onward and backward, surpluses are shifted into columns showing a deficit, under adequate allowance for changed yields. The possibility is obtained by dividing the total of the first column, as it stands after shifting, by the length of a period.

The method does not work towards normal age gradation. The shifting of volumes is times taking, and the method is not in use nowadays.

Charles Heyer Method

By cutting the actual annual increment, the growing stock is left undisturbed. In order to convert the actual growing stock into a normal growing stock, it is necessary to decrease the annual cut if the normal growing stock is larger than the actual growing stock; and to increase the cut if the normal growing stock is smaller than the actual growing stock. Heyer expresses this idea by the formula: The annual possibility (P) is equal to the sum (S) of the expected average increments diminished by the $n'th$ part of the difference existing between the normal growing stock (Ng) and the actual growing stock (Ag).

$$P = S - \frac{Ng - AG}{n}$$

"n" is the number of years forming the installation period.

The field work in this method is timestaking; especially so under the selection system or group system when the actual growing stock can be ascertained only by complete valuation surveys. On the other hand, the method prevents any over-cutting or any under-cutting of the forest, and shows clearly how much of the revenue obtained is, in fact, net revenue and not capital withdrawn; or, how much of the revenue is left latent, being used to increase the original growing stock. This method is well adapted for irregular forests. The method requires:

1. A detailed description of compartments giving the normal and actual volume, and the normal and actual increment for each compartment.

2. A statement showing the normal growing stock, the actual growing stock, and the total increment for the period of installation.

3. A statement enumerating the compartments in which the possibility is to be cut.

No particular stress is put on reaching a normal gradation of age classes.

Hundeshagen Method

Hundeshagen assumes that the ratio existing between the increment and growing stock is constant. With the help of yield tables, he ascertains the ratio existing between normal increment and normal growing stock

and, further, the actual growing stock found in the forest. Multiplying the actual growing stock by the above ratio, Hundeshagen obtains his actual possibility of the forest.

In normal forests (yield table forests), the ratio is necessarily at an optimum. If that optimum is applied to abnormal forests, over-cutting seems the necessary consequence. Absurd results are apt to crop out if the growing stock is under normal and the increment poor.

Inasmuch as the method requires periodic stock taking, over-cutting or under-cutting the forest for any length of time is, however, excluded. Indeed, any method is good which controls its own results by periodic stock-taking. Hundeshagen's method is applicable to all sorts of silvicultural conditions, and might well be applied in a tentative first working plan. In that case, it will be sufficient to express the ratio, "normal increment over normal growing stock" by the fraction $\frac{2}{n}$.

Common Increment Methods

The increment methods are the oldest and roughest methods of yield regulation. The underlying idea is the following: As long as only the increment is cut — no more, no less — an over-cutting of the forest is impossible. The average production per acre can be ascertained from yield tables, by systematic experiments, or, as is the usual practice, by estimating.

The methods do not pay any attention to normal growing stock, normal age, gradation and normal increment. The methods are not applied anywhere, nowadays, in scientifically conducted forestry.

Brandis Method

The Brandis method was first applied by Sir Dietrich Brandis in the Teak forest of Burma. The method ascertains the number of mature trees in a forest as well as the time which an equal number of trees styled "immature," next in diameter to the mature class, require to grow as large as the mature trees are, so as to be fit to replace them.

Dividing the number of mature trees by the period of replacement,

the annual possibility of the forest is ascertained. The method perpetuates the original composition of the forest, calling it normal because natural.

An illustration might be obtained from the data contained in bulletin No. 32, Bureau of Forestry, prepared by F. E. Olmsted:

Diameter of mature trees, 20 inches and over.

Number of mature trees, per acre, 4.94.

Number of immature trees, having 15 inches to 19 inches diameter, per acre, 4.99.

Number of years required by a 15-inch tree to mature, 34.

The annual possibility, after Brandis, in this case amounts to

$$\frac{4.94}{34} = 0.145$$

mature trees per acre, or 145 mature trees for every 1,000 acres.

After bulletin No. 32, the volume of the trees having 20 inches over at breast height is 4561 feet b. m.

The possibility in lumber is, consequently,

$$\frac{4561}{34} = 134$$

feet b. m. per acre per annum.

Methods Regulating the Investments and the Returns

The methods to be described are:

Judeich Method.

Raess Method.

Schenck Method.

Judeich, Raess and Schenck advocate conservatism only when conservative forestry pays better than destructive forestry.

A "sustained yield" is considered only where it guarantees better financial results than an irregular yield.

No two forests are alike. The financial development of any forest offers a problem of its own; on the basis of a difference existing in the resources of the forest; the accessibility of the forest; the availability of manual labor; the climate; the dangers threatening the forest, etc.

Aside from these tangible differences there is invariably met another intangible difference in two forest problems otherwise comparable,— due to a difference in ownership. Among the problems confronting the managing forester, the most difficult is, perhaps, the task of ascertaining the definite desire of the owner. This task is more trying in the case of individual ownership than in the case of stock companies.

Working plans cannot be made for a forest when an owner, lacking continuity of purpose, is subject to whimsical fluctuations of mind; or when the owner's financial status happens to be of a shaky nature.

It must be clearly understood, on the other hand, that a "working plan" is a plan merely outlining a definite policy; a policy to be followed as long as (and no longer than) the economic conditions surrounding the financial problem remain unaltered.

The market of forest products in America is — unlike the German market — an interstate market, not a home market.

In Germany the sustained yield of the forests is framed, essentially, with a view to the consuming capacity of a home market.

In this country, so far, no attempt is being made towards the adjustment of a supply of lumber and demand for lumber — with the exception only of the cypress industry which, controlled by firms of remarkable strength, seems effectually to establish an equilibrium between lumber demand and lumber supply.

In the production of the hardwoods and of pine, concerted action of the producers towards a similar end is, for the time being, a pious wish.

"Concerted action" of the producers is usually decided as a "trust." From the patriotic standpoint, no more beneficial trust can be imagined than a lumber trust.

The German sustained yield, adopted by practically all owners of stumpage, amounts to a "trust-yield."

There is no possibility — neither abroad nor here — to establish an absolute equilibrium between production of trees and consumption of lumber, the latter being subject to continuous fluctuations, whilst the former allows only of slow alterations.

The American producers, with rare exceptions, have never attempted to curtail the output of the lumber industry. On the contrary, when the

BUSBEE RANGE, BILTMORE FOREST, NORTH CAROLINA.

CUTTING YIELDED 60 CORDS OF TANNIC ACID WOOD AND FIREWOOD PER ACRE. GROUP OF FORESTERS FROM THE BILTMORE FOREST SCHOOL.

BILTMORE FOREST, NORTH CAROLINA.

THE TREES CUT WERE SPANISH OAK, GUM, SOURWOOD, HICKORY AND CHESTNUT. THE TREES LEFT ARE WHITE OAK, YELLOW POPLAR (TULIP TREE) AND BLACK OAK.

price of lumber was low, when the margin of profit was small, the producers have usually increased the production so as to obtain the surplus receipts required to meet pressing financial obligations (mortgages, bonds, notes due, etc.).

The output of the lumber industry has risen by leaps and bounds; and it is astounding that the prices of lumber have advanced, nevertheless, by bounds and leaps.

The advance of lumber prices is certain to continue, the available supply of merchantable timber declining from month to month.

An increased production of stumpage we may expect, indeed, to take a start when the price of stumpage has increased at a ratio proportioned to the increased price of lumber.

Still, many a year must elapse before an increased production of trees can result in increased offerings of lumber. In the meanwhile, the famous "law of demand and supply" is set at rest; and prices will continue to climb upward.

Judeich Method

Judeich's method treats every part of the forest according to its own financial merits. The management of the forest as a whole is merely a consequence of the requirements of the individual woods composing it. Sustained yield of volume or money does not underlie Judeich's method. Where the capacity of the market requires it, however, sustained yield is advised.

The treatment for each piece of wood is prescribed in detail for the next working period. From these prescriptions the total volume yield of the period as well as the total area to be cut during the period is finally ascertained.

The normal growing stock is entirely disregarded. Working plan periods shall not exceed ten years; and every five years a thorough revision of the entire working plan shall take place.

Judeich puts great stress on the development of proper cutting series (small). The lumberman's axe is meant to enjoy freedom of action and a multitude of points of attack.

For each working section the financial rotation is determined. Judeich

realizes, however, that the financial rotation is subject to change and is satisfied with fixing it approximately. The plan of cutting embodies the following points:

There must be cut:

1. All economic necessities, especially severance cuttings.
2. All decidedly mature woods the indicating percentage of which is too low.
3. All woods must be sacrificed to the proper progress of the axe within the cutting series; for instance, a group of polewoods lying between two mature pieces. Whether such a sacrifice should be made or not is answered according to the rules of forest finance.
4. All such woods as are about to mature, as far as such woods can be reached by the axe in the proper progress of cuttings. These are the pieces for which an exact examination of the indicating percentage is particularly desirable; which, however, are so near financial maturity that mistakes made will entail small losses only.

By summing up the areas and yields of the above headings, the periodical yield is ascertained. Control is required whether or not the market is able to consume that yield without changing the prices of forest produce on which financial calculations are based. The contents of the working plan are as follows:

1. Actual conditions of the forest.
2. Compartments, cutting series, plan of road building.
3. Yield.
4. Future treatment, silviculturally, and forest utilization.
5. Detailed descriptions of compartments and sub-compartments.

Raess Method

The method recommended by Dr. Raess might be termed the method of sustained money yield. The method pays full attention to the silvicultural as well as the financial requirements of the forest, and gives the

forester great freedom of action. Raess realizes the financial mistakes due to a strictly sustained timber yield, and finds, on the other hand, that a sustained money yield is a necessity for the proper balance of annual budgets in case of wood-owning families, communities, or states.

Like Judeich, he treats every piece of the forest according to its financial merits. If the revenue thus obtained exceeds the normal revenue, when the excess is placed in a bank and left over for lean years, etc, The normal revenue is that which brings the normal indicating percentage on the capital value of the forest. Normal growing stock and age gradation are discarded. Periodic stock-taking, not of timber but of values, forms part of the working plan. Over-cutting as well as under-cutting is thus prevented. The enormous amount of bookkeeping required has prevented the introduction of this method in the German practice.

Schenck Method

Schenck foots on the belief that forestry is business; and, enlarging upon this truism, that forestry is at its best when it pays best.

Schenck's working plans do not advocate conservative forestry; they advocate destructive forestry whenever the destruction of the trees promises the best financial results; they advocate conservatism — to a lesser or higher degree — where conservative management seems to be the most productive of dividends; they advocate a policy of patient waiting whenever it recommends itself financially.

Schenck's working plans are, consequently, according to the exigencies of the situation and of the owner:

either merely plans of silvicultural development;
or merely plans of forest protection;
or merely plans of utilization;
or plans combining silvicultural advice with a distinct plan of lumbering and forest protection.

Schenck's working plans are characterized by the following:

1. After revising in detail the investments existing in the forest, Schenck shows the most opportune level to which the various components

of the investment shall be either raised or lowered. Bad investments must be eliminated. Good investments must be added.

2. Schenck considers, as sources of forestal revenue, not merely the trees but as well the farms, the meadows, the pastures, the minerals and the water powers available on the forest property.

3. Schenck forecasts the cash revenue obtainable from the adjusted investments — not merely the yield in lumber and wood; he confronts the forecasted revenue with the revenue obtainable from unadjusted investments.

4. In plans of conservative forestry Schenck insists on the necessity of permanent protection from fires and of permanent investments to provide facilities of transportation.

5. Schenck insists that in forestry as in railroading, banking, insurance, etc., calculation at compound interest must be applied to the comparison of receipts and expenses.

6. Periodic stock taking is demanded, so as to control, from time to time, the actual status of the entire investment.

7. Trees are either good or bad investments, and should be treated— as individuals or as aggregates — according to their financial merits. The trees are divided into four classes:

(a) Money makers, promising to increase in stumpage value at a rate of interest higher than normal; trees to be preserved.

(b) Indifferent trees, yielding a normal rate of interest, merely, through growth in volume, value and price; trees to be preserved or cut.

(c) Idlers, merchantable trees yielding an inadequate rate of interest; trees to be cut.

(d) Weeds, trees of negative value (not merchantable), never promising any revenue; trees usually left to rot.

Practical experience in the woods, in the mill and in the office is required to allot a given tree correctly to one of the four classes given. Volume tables are of little use in the determination of the maturity of a tree.

8. A sustained yield is recommended only when it promises greater safety or higher remunerativeness of the investments.

Schenck's working plan reports consist of the three parts as already described, viz.:

first part, detailed statement of facts;

second part, statement of the owner's desire;

third part, detailed plan of action.

The plan of action weighs the financial merits of all methods of development or treatment possible under the prevailing conditions and shows the financial superiority of its own recommendations over any other proposed plan of management.

The heads under which the first part and the third part are treated should be those given under the heading, " Forest Utilization."

The " installation period " is the time required for the proper adjustment of all investments.

The annual working plan is an annual budget. It dwells in detail on that part of all provisions of the chief working plan which should be carried out in a given year of the period of installation.

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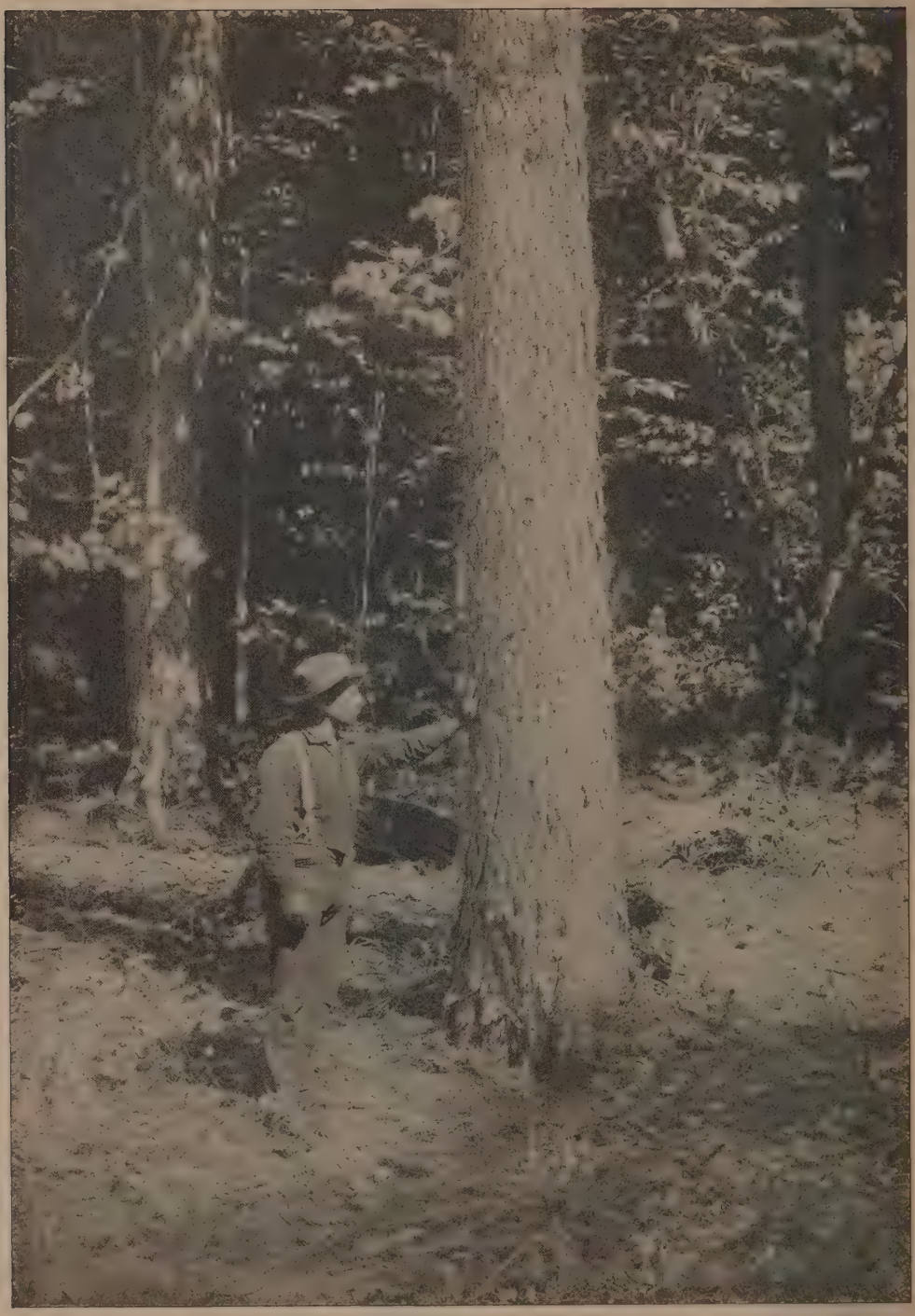
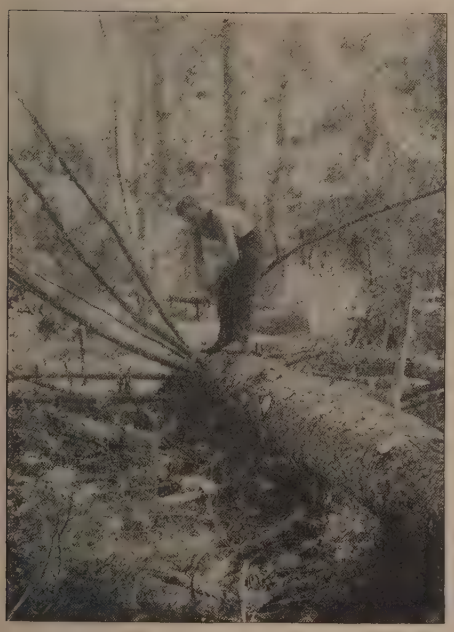


Artificial Preservation of Timber*

By Harry V. Radford, M.Sc., C.E.



WOOD has at all times been the most important and the most extensively used constructive material employed by man. In buildings and in engineering works of every description it is especially indispensable, and it is not probable that it will ever be superseded by any other substance. Such materials as stone, wrought iron, cast iron, tin, copper, zinc, lead, cement, mortar, concrete, brick, tiling, terra-cotta and artificial stone have but fractional employment in comparison with wood; and even the increased use of steel in recent years has not lessened proportionally the amount of wood consumed. In fact, it is notable that, for every decade since 1860, the per capita consumption of wood and timber in this country has increased from 20 to 25 per cent., and there is no reason to believe that the amount used will be lessened in the future.

As might be supposed, wood is possessed of many qualities which contribute to its popularity and utility in construction: it is light, strong, durable, relatively abundant, cheap, adaptable, easily transported, easily worked, and frequently beautiful.

Unfortunately for the welfare of the country, the timber supply has been drawn upon so heavily during the last thirty years, and with so little

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regard to economy, or provision for the future, that, at the present time, not only are we facing a serious timber famine, but the national health is endangered, industry has been crippled, agriculture compromised, property — and in many instances life — rendered insecure, and the beauty and attractiveness of the landscape materially diminished. Floods, droughts, the contamination and discoloration of streams, the extermination of valuable wild game and fish, and the impartment of a desolate appearance to vast areas intended by Nature to be pleasant retreats for the soul-weary, recreative grounds for the sport-loving, and natural sanatoria for the enfeebled and over-taxed, are some of the evils which have followed in the train of unreasoning forest decimation.

Rapid Decrease of Standing Timber

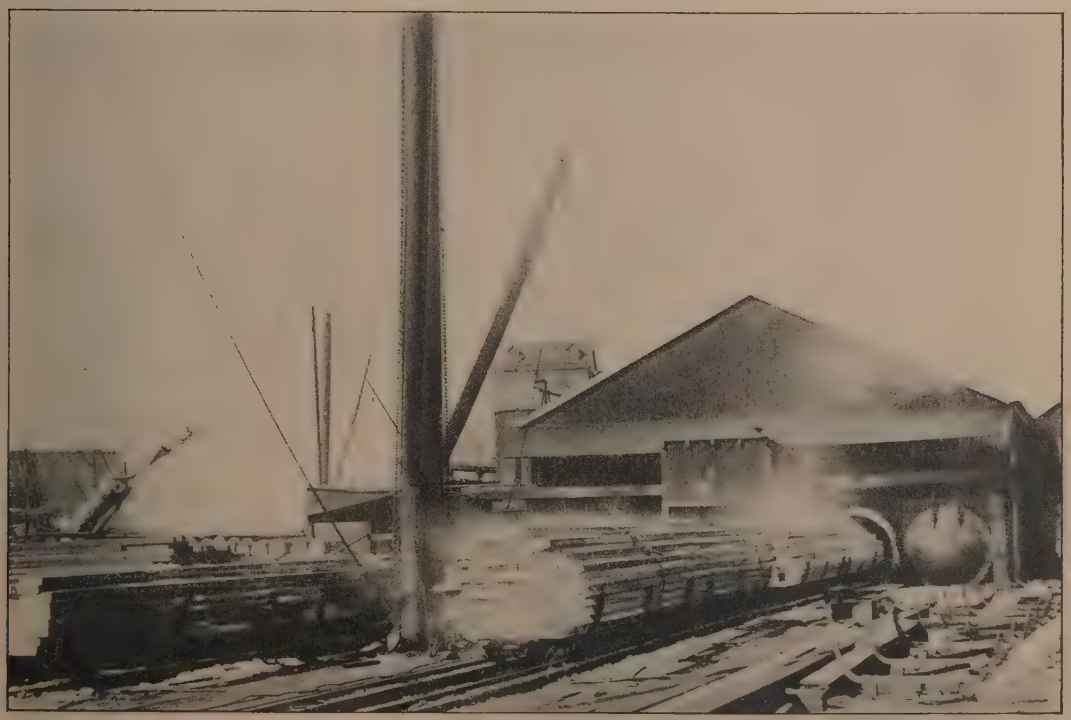
The alarming condition of affairs, with regard to the approaching timber famine in the United States, was thus summarized, in 1890, by Dr. B. E. Fernow, then Chief of the Division of Forestry, of the Department of Agriculture:

"The area of timber land in the United States, although changing daily by clearing of new farms and by relapsing of old ones into woodland, may roughly be placed at 500,000,000 acres. All we can do is to estimate the range of possibilities.

"With the utmost stretch of imagination as to the capacity of wood crops per acre, if we allow even the entire area of 500,000,000 acres to be fully timbered, and keep in mind the enormous yields of the Pacific coast forests, 1,250,000,000,000 cubic feet of wood is all that could be crowded upon that area. This figure would far exceed the most highly colored advertisement of a dealer in timber lands, except on the Pacific coast; in fact he would be afraid to assert one-half as much, for it would make the average cut of timber per acre through the whole country 10,000 feet, board measure. The above figure in cubic feet represents wood of every description, allowing as high as $33\frac{1}{3}$ per cent. for saw timber. Since we consume between 20,000,000,000 and 25,000,000,000 cubic feet of wood of every description annually, 50 to 60 years would exhaust our supplies, even if they were as large as here assumed, and if there were no additional growth to replace that cut and no additional consumption."

Photo by Harry V. Radford.

CAR LOADED WITH TIMBER (3⅞ × 4 SEWER STAVES) ENTERING CYLINDER.



CARLOAD OF TREATED TIMBER COMING FROM CYLINDER.

Since making this statement, Dr. Fernow has predicted the complete exhaustion of America's timber supply within thirty years, providing the present rate of consumption is maintained.

From these deductions it is evident that the problem of conserving our timber supply, or at least putting the ultimate destruction of our forests as far into the future as possible, is one which not only interests, in a general way, the entire population of the country, but is especially important to all such as are concerned, in any way, with the manufacture or use of lumber, timber and wood, and of the various products of the latter; and particularly to the engineer and architect, the carpenter and builder, the manufacturer, lumberman, and mill owner, the newspaper and book publisher, and all other consumers of wood pulp and paper.

Within the past twenty years efforts, more or less serious, have been made to introduce into this country systems of forestry which would help to conserve the supply; but it may be said that, in general, "scientific forestry," so called, has, up to the present, accomplished, in America, little more than the elevation of "the service" to the dignity of a profession, and the awakening of a wide-spread public interest in the subject.

Importance of Artificial Preservation

Fortunately, however, while little progress has been made in the direction of systematic or economic lumbering, or of provision for the existence of future forest trees to supply the demand for wood in years to come, there have been introduced and developed in this country, within the past generation, several methods for arresting the decay of sawn lumber and piles, and for preventing the attacks of the various marine and land wood-borers. In so far as, by preserving from attack and preventing the decay of wood, they lengthen the life of a stick of timber, and thereby lessen the number of sticks required to keep a structure in repair, the individuals and corporations engaged in experimenting with and developing these preservative processes, are not only opening the way for a great saving of money and labor in the maintenance of nearly all classes of structures, but are contributing in a most important manner to materially check the annihilation of our forests, and to stimulate the development

of practical forestry economics. Perhaps but few persons have considered the preservation of timber from natural decay and from wood-destroying animals in this light; yet it is perfectly evident that to prolong the life of a piece of manufactured lumber, or of a pile, is to aid in the work of perpetuating the forest quite as effectually as to guard the untouched trees themselves from fire or axe.

Kinds of Timber Rot

The decay of manufactured lumber, and of timber and piles, may be due either to dry-rot or wet-rot.

Dry-rot may be caused by painting green, unseasoned timber, or it may occur naturally, as when timber is kept in confined air, without ventilation. In this case, whether or not moisture be present, dry-rot may be occasioned, and the wood at last converted into a fine powder. This condition is often noticed in sills and posts of old framed buildings and at the ends of joints imbedded in brick and masonry walls.

Wet-rot is the gradual disintegration and decomposition of all organic matter when exposed to air and moisture, that is, alternate wetness and dryness, as seen in timber lying on the ground or as exposed in a structure. It also occurs in all surfaces of contact, as in the joints of timber frames where the air is more or less confined and heat is developed, although the degree of moisture is slight. Moisture is essential to wet-rot. This form of decay is also developed in the tree while standing and growing, as is often seen in hollow trees. Wet-rot is in reality the growth of bacteria or fungus.

Destructive Animal Forms

The forms of animal life seriously destructive to commercial timber may be divided into marine wood-borers and land wood-borers. There are some fresh-water wood-borers, but they are very rare and their injuries are generally negligible.

Of the marine wood-borers, the common ship worm, or teredo, and the limnoria, are the best known and the most destructive. The chelura is of more recent discovery in this country, and the extent of its depredations is not yet fully known.

Seven species of the teredo have been identified in North American waters. They are the *Teredo navalis*, the *Teredo norvegica*, the *Teredo dilatata*, the *Teredo megotara*, the *Teredo thompsono*, the *Xylophaga dorsalis*, and the *Xylotrya fimbriata*. They are all similar in their principal characteristics, but their range varies. Thus, the *Teredo navalis* inhabits Atlantic waters, in America from Cape Cod to Florida, and in Europe from Sweden to Sicily; and the *Teredo norvegica* from Cape Cod northward to the coast of Maine; while the *Xylotrya fimbriata* abounds in North Pacific waters.

WORK OF THE TEREDO.

UNTREATED TIMBER COMPLETELY DESTROYED IN 18 MONTHS CAPE HAYTIEN, W. I.

WORK OF THE LIMNORIA.

SECTION OF SPRUCE PILE, UNTREATED, AFTER 7 YEARS USE AT NEWFONDLAND.

The teredo is a true mollusk, and its popular designation of ship worm is correct only in so far as its long thin body resembles a worm. In general appearance it might be said to suggest a soft shell clam with an unusually long neck and a very small shell. It is exceedingly destructive to nearly all kinds of timber, and is most active in southern waters. The claim has been made that the Australian jarrah is immune from its attacks, but if this be true it is perhaps the only exception.

One of the worst features of the work of the teredo is the minuteness of the perforation which it makes in the outer surface when entering a pile or piece of submerged timber. While these apertures may be almost invisible, the destruction wrought within may be very great indeed, and

not infrequently a pile is so completely honeycombed interiorly (without exterior evidence of unsoundness) that a slight blow would suffice to break it in pieces. It is common enough for the teredo to destroy, with its tunnels, from 50 per cent. to 70 per cent. of the cross area of the piece of timber attacked. Fortunately, the marine wood-borers are able to work upon submerged timber only between the mud line and low-water mark.

The action of the *Limnoria terebrans*, while hardly less destructive than that of the teredo, is chiefly upon or near the surface, so that timber which it has weakened may be readily detected. The work of the chelura closely resembles that of the limnoria.

The principal land insect which attacks manufactured lumber is the white ant, or termite, a wood-borer whose work is very destructive. It is confined to southern latitudes, and is especially harmful in South America. There is a black ant which infests the northern forests, and which riddles wood of the pine family so as often to remove, by excavation, one-half of its cubic contents, but the writer is not aware that it preys upon manufactured lumber.

Various Preservative Treatments

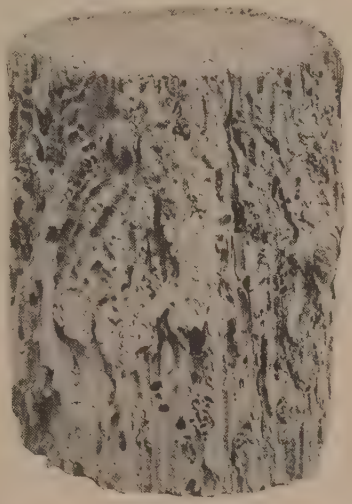
For many centuries efforts have been made to discover a suitable treatment which wood could be made to undergo which would, at the same time, preserve it against decay and the attacks of boring animals. The number of experiments made has been legion. One writer (Paulet) enumerates 174 different processes which had been tried. From the earliest times wood has been charred; and there are piles in Venice and in England more than one thousand years old which seem never to have been treated by any other process save charring. Apparently, the ancients had a method of doing this which is now a lost art, for the results of charring now-a-days are not very satisfactory.

Later came a period when wood was coated with preservative paints; and finally attempts were made to inject preservatives into the wood. The painting processes and other external applications have gradually fallen into disuse, as it was found that by covering the outside of timber with an impervious coating the evaporation of water was stopped. This allowed any chance fungus spore, which may have been on the wood before coating, opportunity for rapid growth, thus hastening the destruction of the wood.

Occasionally a few of the processes are still advocated, but the general belief now is that they do more harm than good.

When the system of impregnation is employed, pressure is used to drive the solutions into the wood. The solutions are usually heated, so as to increase the amount pressed in, as hot solutions penetrate porous matter more readily than cold. There are a number of materials in use for impregnating wood, the most important of which are:

SECTION OF PILE TREATED WITH DEAD OIL OF COAL TAR.



SECTION OF PILE UNTREATED.

THESE PILES WERE DRIVEN AT THE SAME TIME AND TAKEN UP TOGETHER. THEY ARE BOTH VIRGINIA YELLOW PINE. THE CREOSOTED PILE WAS TREATED WITH 14 LBS. OF OIL. THE TREATED ONES ARE GOOD FOR AN INDEFINITE PERIOD, HAVING BEEN IN USE (C. R. R. OF N. J.) OVER 14 YEARS.

Copper sulphate ($CuSO_4$),
Zinc sulphate ($ZnSO_4$),
Zinc chloride ($ZnCl_2$),
Mercuric chloride ($HgCl_2$),
Aluminum sulphate [$Al_2(SO_4)_3$],
The products of coal-tar distillation, including, chiefly, creosote, or dead oil of coal-tar.

The theory upon which the injection of salts into wood is based is that the salts act as poisons, killing the fungi or bacteria which grow in wood and destroy it. The secret of success is in pressing in sufficient of the salt so that it may not be leached out for a long time — as these salts are all soluble in water.

Besides charring, coating and impregnation, there are a few other methods of protection which have had some success, and which deserve mention, although it is now generally recognized that no method compares in effectiveness with impregnation, and especially impregnation with dead oil of coal tar, or creosote.

Removal of submerged timber during the breeding season of the borers has been tried, but it is often impracticable, and always so when the breeding season is long, as it is in the South.

A change of water will sometimes save timber from the attacks of marine borers. Wooden vessels have sometimes been hauled into fresh or muddy water and thus made immune. The suggestion has been made that expensive wood-work might be surrounded by fresh water, which is never infested by the teredo, limnoria or chelura.

It is claimed that if the bark is left upon piles when submerged they will be safe against attacks by the teredo, which seems to be reluctant to cross seams. But this method is hardly of any use against the limnoria; and the bark soon wears away, when the pile is as vulnerable as manufactured lumber.

Metallic sheathings, such as copper and zinc, have been used with considerable success. The chief objection to such sheathing is the large cost, because it cannot be denied that they are effective, especially sheathings of copper.

Sheathings of many other materials have been tried. Such attempts have included:

A mixture of paint with some fabric such as burlap or wire netting.
Paraffine, tar, asphalt, etc.
Portland cement.
A jacket of ordinary cylindrical sewer-pipes of earthenware, with joints sealed.

"Teredo nails," sometimes called "worm nails," have been in use in Holland for many years, and are said to have been employed by the ancient Romans. They have short spikes, with large, flat heads. These nails are driven into the piles, or piece of timber, very close together, and are reported to be very effective in repelling the teredo. But the nails rust and wear out in time, and have other disadvantages.

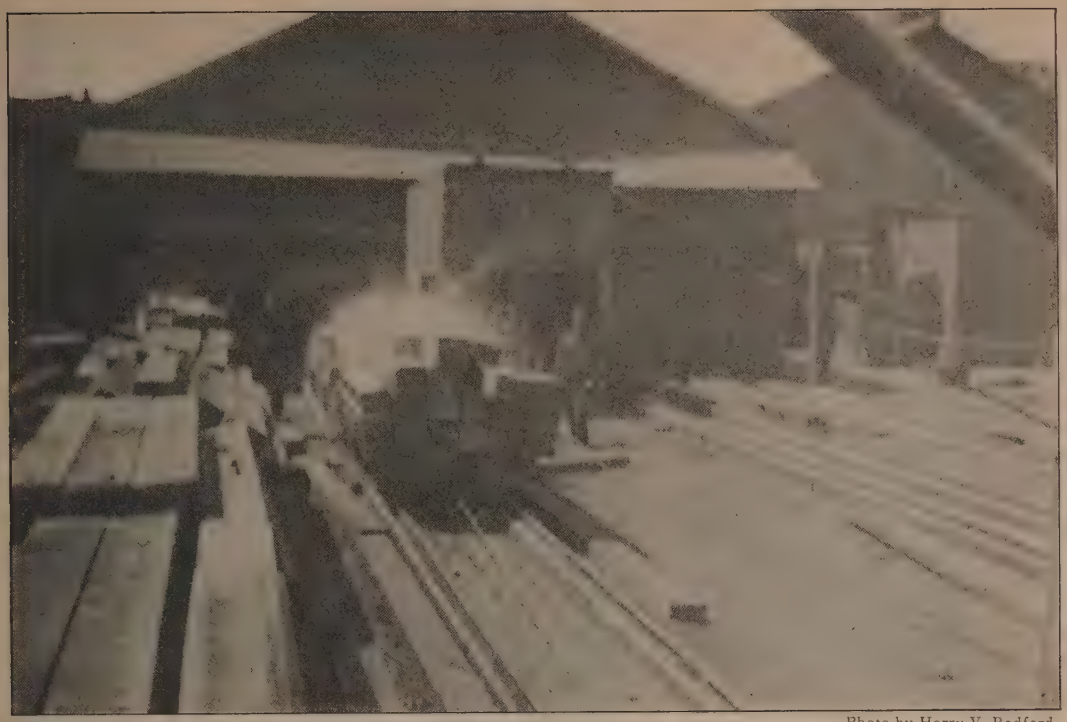


Photo by Harry V. Radford.

CARLOAD OF TREATED SWITCH-TIES AT THE MOMENT OF EMERGING FROM CYLINDER.

Photo by Harry V. Radford.

UNLOADING 2 × 6 TONGUE-AND-GROOVE PLANKS, WHICH HAVE JUST BEEN TREATED.

Impregnation the Best Method

As remarked above, none of these expedients is comparable with impregnation; and the latter method, in this country, is almost exclusively in use. Nails, metallic sheathings, and the retaining of the bark upon piles, have been liberally tested, but in almost every case impregnation is finally resorted to.

In the United States most of the large impregnating plants are located in the Southwest. Inquiry of the Forest Service, Department of Agriculture, elicited the fact that there are but six such plants in the Eastern States. They are:

Eppinger & Russell Company. Long Island City, N. Y. (Creosoting.)
Atlantic Creosoting and Wood Preserving Company. Norfolk, Va. (Creosoting.)
Norfolk Creosoting Company. Norfolk, Va.
Wyckoff Pipe and Creosoting Company. Portsmouth, Va. (Creosoting.)
Otis Allen & Son. Lowell, Mass. (Kyanizing.)
United States Wood Preserving Company. Perth Amboy, N. J. (Creosoting.)

It will be noticed that of the six firms mentioned five impregnate with creosote, while but one impregnates with a salt (Kyanizing, a process invented, patented and applied in England by John Howard Kyan, and in use since 1832 — in this country since 1840). This is a fair indication of the relative popularity of the two methods, and it is not disputed that, at the present time at least, the creosoting process is the one taken most seriously by the majority of engineers and builders.

I sent for and obtained the literature issued by all of the Eastern plants, and made four visits to the works of Eppinger & Russell, in Long Island City. An examination of the advertising matter sent out by the five creosoting establishments indicates that, in the main, their methods of treatment do not vary, so that a description of the plant and process of the Eppinger & Russell Company, which claims to be the largest concern of its kind in the world, will amount practically to a description of the wood preserving process in greatest favor among engineers in this coun-

try to-day, and which doubtless has the largest number of important advantages in its favor.

A Typical Creosoting Plant

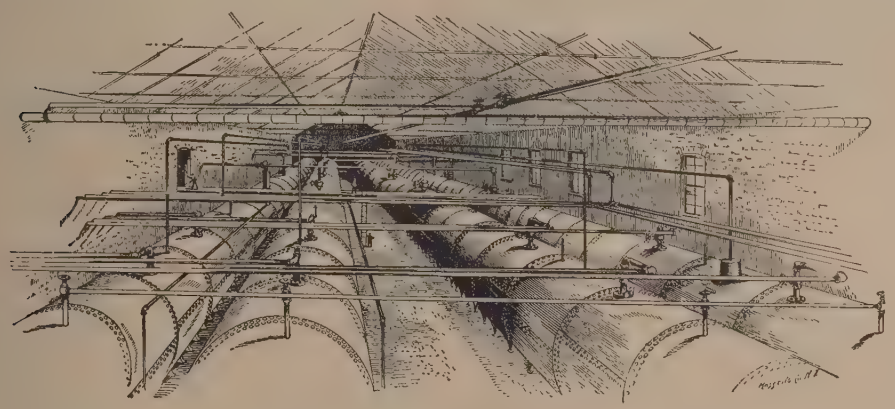
The Eppinger & Russell creosoting works occupy about four acres of land at the junction of First Street and Newtown Creek. There are 600 feet of dock front, with twenty-one feet of water. A spur of the Long Island Railroad enters the yard. Most of the space in the yard is utilized for piling up the timber, ties and piles which have arrived and are awaiting

EPPINGER & RUSSELL CO'S CREOSOTING WORKS, FIRST STREET AND NEWTON CREEK, LONG ISLAND CITY, N. Y.

treatment, or which have been treated and are awaiting shipment, and for storing treated timber owned by the company and which the latter keeps in stock for those who desire to purchase direct from them instead of having their own material treated.

The piles of treated and untreated timber and logs are all interesting. I took a number of photographs of them. Here was a large stack of long piles (seventy-five feet) from North Carolina, via Norfolk, Va., and which, after treatment, were to go to Porto Rico for docks of the New York and Porto Rico Steamship Company. There was a lot of stock piling — yellow pine from Norfolk. They were of uneven lengths — thirty-five to sixty

feet. These the company sells in the open market. Six thousand of them had been sent to Staten Island during the last year; others to Sydney, Nova Scotia; Atlantic City, and so on. These piles receive from twelve to eighteen pounds of the oil per cubic foot. The yard contains all sorts and sizes of timber, lumber, planks and piles. They are constantly arriving on vessels from all parts of the country, and, after treatment, are shipped far and wide. Much of the material is exported to European and Asiatic countries, but the bulk is used along the atlantic seaboard from Labrador to Florida, Mexico and South America. Some red and white oak is received for treatment, but the principal timber is the common yellow pine of Virginia, the Carolinas and Georgia. It is comparatively cheap, and makes



INTERIOR OF CYLINDER HOUSE.

excellent material for practically every purpose to which creosoted wood can be put.

The treating plant consists of four immense iron cylinders, six feet in diameter and one hundred feet long, capable of standing a pressure of 180 pounds to the square inch, with movable heads weighing over three tons each. Into and through these cylinders lead tracks, and upon these tracks move the metal cars carrying the timber to be treated. In each cylinder are large and heavy pipe heaters or coils, capable of maintaining 250 degrees Fahrenheit of heat (which is the maximum heat used). There are three steam boilers of 250 horse-power, two super-heaters, pyrometers, gauges, condensers, etc.; three large vacuum pumps (16 inches), two pressure pumps, two large pumps for handling oil, and three pumps for water and fire purposes.

There are six large oil tanks capable of holding 300,000,000 gallons, four hoisting engines, forty cars for handling timber in the cylinders, eight double derricks, a well-equipped machine shop, etc.

I was told that the dead oil of coal tar costs them ten cents per gallon in New York, and that most of it is purchased from the Barrett Manufacturing Company. I called at the latter's office in Battery Place, seeking particulars as to their method of producing the oil, but was refused the desired information. Neither did the company issue any descriptive or informatory literature. It was claimed that they employ a secret process for obtaining this oil, which is one of the products of the second distillation of coal tar. Many other valuable products are obtained by these distillations, including lamp-black, and several others used in dyeing.

The combined capacity of the Eppinger & Russell plant is 90,000 feet, board measure, in each twenty-four hours. The cylinders being 100 feet long, almost any size of material can be treated.

Method of Treatment

When the timber has been loaded upon the cars, it is run into the cylinders, which are then hermetically sealed with the immense iron heads. These are made tight by means of rubber gaskets and ingenious locking bolts. I made three pencil sketches showing the method of fastening on these heads, which are herewith presented. After the vacuum has been applied, it is usually found necessary to give the nuts on the locking bolts a few extra twists to make the heads more secure.

Steam is first admitted into the cylinder surrounding the timber; super-heated steam is also introduced into the cylinders by means of large coils, so that it does not come in contact with the timber, and heat is maintained until the timber is warmed all through at a low temperature, so as not to injure the woody fibres. The cylinder is then freed of all vapors, and the vacuum pumps are put to work to exhaust all the sap and moisture — which is then in the shape of vapor — from the cylinder. Heat is maintained in the coils to prevent the vapor from condensing and thereby remaining in the timber. As the vacuum pumps are constantly removing the hot vapor from the timber, it is necessary to keep the heat above the

Photo by Harry V. Radford.

LONG PILES AWAITING TREATMENT.

DESTINED FOR PORTO RICO.

Photo by Harry V. Radford.

UNLOADING TIES FROM A VESSEL JUST IN FROM NORFOLK, VA.

condensing point, and yet not too high. This is one of the points upon which practical experience is necessary, and theorizing of little account.

After this the oil is admitted into the cylinders while they are under vacuum; and when all air has been withdrawn they are subjected to pressure until the requisite amount (determined by gauges) has been forced into the timber, which, if the timber has been properly prepared, is only a small part of the process. If all the sap, moisture and vapor have been extracted from the wood, the oil will enter the pores readily; but if these have not been thoroughly withdrawn, no amount of pressure will be able to force in the oil, since the two substances cannot occupy the same place at the same time. It may be said that the whole secret of successful creosoting lies in getting the timber properly prepared for receiving the oil, and for this the first and most important condition is that all fluids shall be driven out. Where creosoting has failed to prevent rot or the attacks of insects it has almost invariably been because the timber was not properly prepared before impregnation; but when properly prepared and treated with a sufficient quantity of oil, the wood is practically immune to rot, impervious to marine and land wood-borers, and indestructible.

There will be no decay in any part of the timber that has been permeated with the oil, but to have all parts saturated is expensive and unnecessary, for, after the timber has been thoroughly treated by the heat and vacuum process (the finest form of artificial seasoning) it will last a long time without any oil, and if the crevices and pores are sealed up with the oil to a sufficient depth, the timber is as good as if the whole part had been permeated with the oil. The quantity of oil to be injected depends upon the use and the locality where the timber is to be placed. The attacks of the land and water insects are worse in the South than at the North, while wood used in underground work, such as electrical conduits, sewers, tunnels, etc., and in other locations subject to great dampness, is more liable to succumb to wet-rot than is that employed above ground and in dry atmospheres. In general, for marine purposes, not less than twelve pounds per cubic foot is advised for the vicinity of New York, and from fourteen to twenty-two pounds where the worm is bad. Twenty-four pounds of oil is about the limit that is ever used.

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NOTE.—Since this paper was prepared, the Division of Forestry, Department of Agriculture, has become the Forest Service.

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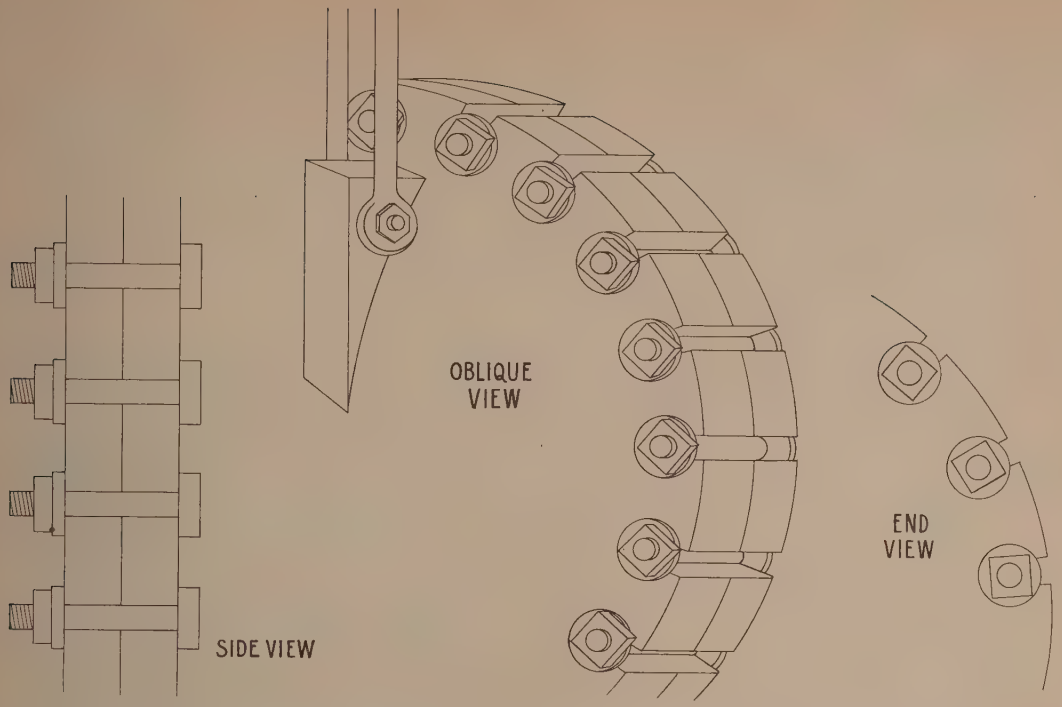
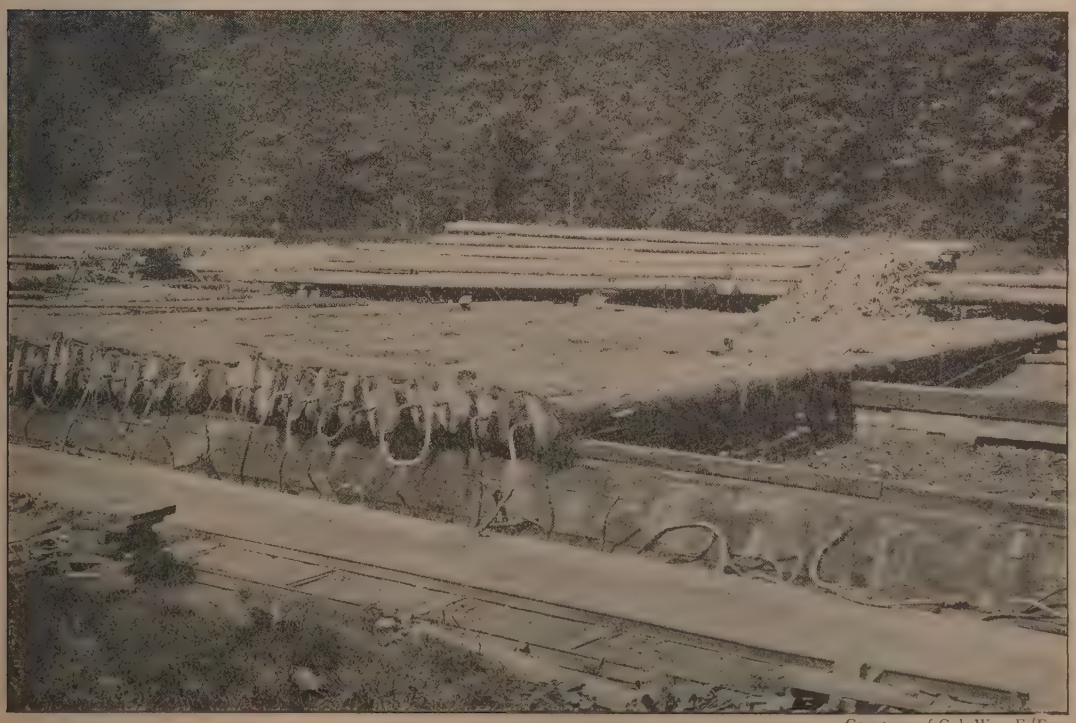


After pencil sketches by Harry V. Radford.

DRAWINGS SHOWING METHOD OF ATTACHING MOVABLE HEAD TO CYLINDER.



Courtesy of Col. Wm F. Fox.

PLANT FOR IMPREGNATING WOOD WITH PRESERVATIVE SOLUTION. TREATMENT OF TELEGRAPH POLES.

SIHLWALD, SWITZERLAND.

Difficulties in Fish Culture

By Tarleton H. Bean, M. D., M. S.

IT is not proposed in this article to mention all the difficulties against which the fish culturist has to contend. Such a paper would easily rival a good-sized book in extent. What I wish to do is to call attention to some of the most serious obstacles with which the State of New York has had to deal during the past year and one-half of its experience. In some cases the difficulties have been overcome, but in other affairs our best efforts have been unsuccessful. In order to facilitate reference to this article, I have arranged the matter under headings which are familiar to all fish culturists. The article has been prepared in the hope of securing, through discussion and by correspondence, some efficient help in the struggle to maintain and increase the supply of fish in public waters.

Excess Air in Water Supply

Eggs of maskalonge at Bemus Point, season of 1907, could not be kept in the jars because of unnatural buoyancy due to excess of air in the water. Eggs of shad at Catskill floated off until Mr. Walters stopped the difficulty by the use of a screen through which the city water was passed before entering the hatching boxes. Another method of removing the excess air is by meandering the supply stream before it enters the jars and fry troughs.

Drought

The amount of flow is so much reduced in some places (as at Guthrie's Brook at Mumford) that the usual number of fry and fingerlings cannot be safely kept there, and thus the output of Caledonia Station is greatly lessened below the average.

During the summer of 1907 fish culturists in many parts of the country were unable to carry their usual stock of fingerlings because of the scant water supply from springs.

Excessive Heat

Very hot summers are fatal to trout except where there is an ample supply of cool spring water. Brook trout are the greatest sufferers, but all species are seriously affected. The ideal trout and salmon water has a surface temperature of 54 to 60 degrees F. in summer.

In rocky streams the heat is more quickly fatal because the stones become superheated and cool off very slowly. The surrounding water is quickly warmed to a degree unsuitable for trout.

Low Temperature in Spring

The shad season of 1907 was unusually late and the egg taking period was correspondingly short. In the Hudson River the Catskill Station was not opened for work until May 13, and it closed operations June 19. The shad entered the river just a little after the usual time, but the cold water retarded egg ripening, and no eggs were secured until May 14.

The same condition affects the spawning of smelt, yellow perch, pike perch, rainbow trout, black spotted trout, and other fish cultural species.

Scarcity of Good Hatchery Sites

One of the important requirements for a hatchery is an ample supply of suitable water which can be obtained by gravity, preferably a stream with a series of small rapids, capable of being dammed and furnishing sufficient water in the dryest seasons. This sounds simple enough, but

such locations are few and far between. When found the water is to be taken off laterally into a hatchery or into ponds secured against injury from freshets. It is rather difficult to find just the right conditions for successful work, and the difficulty is too often increased by the importunities of persons who have some private interests to advance in the selection of a site, and who bring to bear influences which are entirely foreign to a proper fish cultural policy.

The use of good streams by mills is often prejudicial to success in fish culture, as they take nearly all the flow for hours at a time, and thus reduce the water which would be available for hatcheries and ponds. The State or other owner of a fish-breeding establishment should own or control all of the stream required for its work, or at least the headwaters.

Transportation Cans Causing Losses

Because of the presence of solder, acid, paint, or some other substance injurious to fish life many fish die in transportation. An article on the subject was published by Mr. M. C. Marsh of the United States Fisheries Bureau.

Carrying lumps of ice in the cans often causes death of fish, and dipping water to let it fall through the air into cans is often very injurious, especially in the case of young fry.

The form and size of the can are important factors in satisfactory transportation, but maintaining an even temperature of the water during travel is still more important. Is frequent aeration of water in transit after all as helpful as some suppose, and is it not sometimes unnecessary and harmful? Minnows have been kept over night without change of water and with no aeration, but in a proper temperature and without loss. The same minnows when exposed to air next day died off rapidly. This was an experiment by Mr. Whipple at Upper Saranac, N. Y.

Defective Car Service

A modern fish car with its numerous appliances for control of temperature, aeration, circulation of water and comfort of its crew is a great aid

to fish culture. In fact any car that is used solely for fish transportation is an improvement over the old system of shipment in ordinary baggage cars, the journey sometimes extending across the continent.

The average State car, however, is not equipped with a great many modern devices for the care of fish and eggs, and is, therefore, less effective than the best types. In some cases a State owns only one car, and then it is sure to be urgently needed in several places at the same time. Accidents are not uncommon resulting in more or less serious damage to the car, and causing delay in the yard for repairs.

Free transportation is not always available, although the railroads, with few exceptions, are very generous in aiding the distribution of fish by this courtesy. Just what effect, if any, the recent legislation upon rates and passes may have on fish cultural progress is problematic at present.

Improper and Impure Food

In these strenuous times, when the annual yield of fish for stocking the waters of a single State, like the Federal appropriations for the support of government, is rapidly approaching the billion mark, the fish food problem has become a difficult one. Nature does not usually furnish the amount of nourishment required in small space for such hungry hordes. Live minnows, insects, crustaceans and mollusks are excellent so far as they go; but few localities away from the sea shore and the big lakes provide an important percent of the food consumed by the fish under culture.

Flesh of various domestic animals, ground cereals and preserved fish eggs constitute the bulk of the supply at nearly all fish cultural establishments, and the cost of food at a single station within my own knowledge often reaches $200 per month. It is therefore not to be wondered at that young fish sometimes get food which cannot pass through the digestive tract without causing inflammation of a serious nature. As a matter of fact many trout are killed in the feeding troughs and ponds in spite of the best care.

Occasionally food of some kind, and especially liver, will spoil or become stale, and if fed to the fish trouble will follow. It often happens that young trout, even after they have entirely absorbed the yolk sac, will

refuse to take liver or any other of the ordinary foods available at a station, and heavy mortality may result through starvation. Such a case was observed among the brown trout at one of the New York hatcheries. Liver emulsion was persistently refused and a great loss of fry was imminent. In this emergency some fresh water shrimp were crushed through a sieve and the juices were introduced into the fry troughs. Apparently this was precisely what the little trout desired. They began to feed almost at once, and the trouble was practically overcome. The juice of snails living in trout waters might also serve a similar purpose when the ordinary food is refused.

Transportation Losses

Loss of Eggs. There is no doubt that in many cases fish eggs are killed in transportation because of inherent weakness derived from the females which furnished them: but serious losses occur also with good eggs from various causes. Sudden changes of temperature not properly provided against destroy many eggs or injure them so badly that they develop weak embryos or none at all. Improper packing material is responsible for heavy mortality. Clean soft moss seems to give the best results. Leaves are not suitable and should not be employed. The egg-tray with a Canton flannel bottom is very satisfactory.

Shock from concussion is a frequent source of trouble. In a storm on one of the lakes several entire cases of whitefish eggs were destroyed.

Insufficiency of ice in the shipping case, and delays in delivering are often followed by severe losses of eggs.

Loss of Fish. Many thousands of fish are killed annually in transportation or as a result of injuries received in transit from one cause or another. Too much or too little aeration of water in the receptacles often proves fatal. Innumerable fry have been destroyed by "dipping" even although with the best intentions. Overcrowding in the cans is responsible for great losses. Poisonous substances accidentally mingled with the water often cause severe mortality. Danger and death often lurk in the fish can unless every precaution to insure cleanliness and purity is rigidly observed. Poison may come from some ingredient of paint or solder: even the water

supposed to be pure may prove to be unfit for fish transportation, and such conditions are usually discovered when it is too late to save the fish.

Pollution of Waters

The contamination of trout streams and rivers and lakes in which valuable fish would live if conditions were favorable is a grave cause of failures in fish culture. Sawdust and other mill refuse, poisonous acids and alkalies from refineries and chemical works, sewage and the drainings from barn yards are responsible for greater depletion of streams and more disease and mortality among fishes than all other causes combined.

Sawdust covers up the spawning grounds, spreads and accumulates on the bottom, ferments and offers a lodging place for fungus to such an extent that it makes a stream uninhabitable for any good fish. Acids and alkalies have been known to kill all the trout that come in contact with them. Sewage and the liquors running from barnyards have spread bacterial diseases among brook trout and brown trout so extensively as to destroy the entire brood stock of some of our most important stations. Sewage is not only a common source of disease among trout, but it is also a menace to the public health, and many serious epidemics are caused by allowing it to escape in streams.

Destruction of Spawning Grounds

Sawdust is not the only deleterious substance affecting the spawning beds of trout, shad and other choice species. Cinders and ashes dumped from river steamers and other craft are working great injury to the natural reproduction of fish. As a recent illustration of this evil may be cited the filling up of the Little Channel, near Tivoli on the Hudson, where no spawning shad could be taken in 1907, and nets cannot even be used on account of the abundance of cinders.

Difficulties in Collecting Eggs

The spawning season of most of the good species utilized in fish culture occurs in the late fall and winter or very early in spring when storms are

frequent and the temperature is low. Great losses of eggs frequently take place on account of bad weather, either from shock in transportation to the hatcheries or by sudden and unavoidable freezing.

It is sometimes hard to locate the spawning grounds of lake trout and white fish, because the fish may desert certain places which they have frequented for years and must be sought elsewhere. Very often it is observed that an excess of males may occur without any corresponding females, or there may be plenty of ripe females and no suitable males. Thousands of eggs have been lost for this reason. Occasionally State employees while collecting or developing eggs in certain waters are attacked and injured by evil disposed persons or the hatching apparatus is damaged at night. Would-be criminals are sometimes very unfriendly to fish culture.

Certain trout as, for example, the black spotted or red throat, introduced in the East originally from Colorado, refuse to yield their eggs in ponds or they may become egg bound and unable to void them. I remember such an instance at Northville, Mich., and it has probably been noted at many other places where ponds are small. In one of the lakes near Saranac Inn, however, where these trout have ample room, the difficulty is partly overcome.

Dams in Streams

Impassable dams in rivers and creeks of New York greatly restrict the up-stream movements of fish as their spawning season approaches. They also make opportunities for unthinking and unprincipled persons to capture large numbers of fish illegally while assembled near such obstructions for spawning purposes. At a point on the Oswegatchie River, for example, a dam more than 200 feet long occupies the whole width of the stream and stops every fish on its vernal ascent intent on reproduction. Sturgeon, pike perch, black bass, maskalonge, etc., come down from Black Lake and are stopped by the dam. They spawn there and then return to the lake. Certain people are always on the lookout for these fish and they catch them by day and at night without regard to law or common sense. What is true of this obstruction applies equally to all and their number is legion. Fishways have been introduced at a few points, but they have generally been destroyed by ice or freshets for want of proper construction.

Lack of Information About the Waters

New York is said to have about 1,400 named lakes besides innumerable ponds without known names. It has two of the Great Lakes on its western border and about 300 miles of sea coast besides the great drainage systems of the St. Lawrence, Lake Champlain, the Hudson, Delaware, Susquehanna, and the Ohio Basins. Certainly there is an embarrassment of riches for the hydrographer and the ichthyologist both of whom should rightly precede the fish culturist, yet New York has done little to make us acquainted with its waters and their inhabitants. There is probably not a single lake or great river in New York which has been studied by an ichthyologist for even as long a period as one month consecutively. We know very little about the kinds of fish in any given body of water, still less about the natural food of the fishes, and almost nothing concerning the results of stocking.

I am, of course, aware that many articles and books treating of aquatic life have been written and that some of them relate to the New York fauna; but a very small portion of their contents has any great significance for fish culture. The scramble for museum types and duplicates and for exploiting the uttermost parts of earth and sea is so continuous and absorbing that few workers are left to investigate the nearby sources of industries and the causes of their decline.

Injurious Fishing

Any method of fishing which prevents fish from ascending streams from the ocean for the purpose of spawning in fresh water is injurious and highly destructive. Such a style of fishing is the setting of fixed nets along the coast at and near the river mouths in a manner to keep out the shad entirely, and thereby cause the failure of both natural and artificial hatching of their eggs. The disastrous effects of this practice are more and more clearly seen year after year. This is not a matter under the control of the State; but New York suffers for the lack of protection farther south.

Illegal Fishing

The persistent and wholesale capture of fish in their breeding season and during the period of winter rest, on their spawning beds and under ice,

is one of the worst obstacles to the success of maintaining the supply. The best directed efforts to keep up the stock are barren of good results because of this destructive practice. Immature fish, even though they have little value as food, are taken and sold in incredible numbers. Whitefish small enough to pack fifty in a cigar box have been sold in large quantities. Barrels full of striped bass under six inches in length may often be seen in Brooklyn and New York markets in the early spring. Small sturgeon under the legal limit of length are frequently caught in shad drift nets and sold for use in the fresh condition or for smoking. This means an enormous waste of good fish and a total disregard of the future supply.

Scarcity of Fish Culturists

It is a very difficult matter to find skilled employees for the hatcheries. In the first place the rate of pay offered by the Federal and State governments is not sufficient to attract the class of men who could render good service. In the second place, there are no schools in which a young man may receive the special training necessary to fit him for fish cultural work. Again, there is such a demand for experts among private establishments and clubs, many of which are able and willing to pay good salaries for satisfactory services that the really useful men are not often seeking employment. Furthermore, the wages of common labor and of ordinary skilled labor so called, are now so attractive that few persons care to enter into governmental fish culture, even with the hope of promotion and a steady income. The State and the Federal service are used by many bright young men merely as a stepping stone for something better. There are only a few enthusiasts who are thoroughly in love with their profession and are willing to make sacrifices for the sake of doing what they believe they can do best.

Cannibalism

Game fish and some other aquatic animals frequently destroy one another to such an extent as to seriously diminish the output of a hatchery. This is particularly true of the black bass, pike perch and maskalonge. In a large pond at Washington, D. C., the United States Fish Commission

once had about 130,000 young large mouthed black bass in May or early June. The bass were regularly fed, and the pond also contained a great many little minnows and sunfish which were freely eaten; yet in November when the pond was drawn down and the bass were removed for distribution only about 30,000 remained and of these there were 500 that weighed nearly one-half pound apiece while the rest averaged scarcely more than two ounces each. Eight bass were afterwards confined in a tank at the station, one of them slightly larger than the rest. In about one week the biggest one had devoured all of its companions.

Pike perch must be planted soon after leaving the egg or they will destroy one another at a frightful rate. As many as a dozen have frequently been observed telescoped one behind the other in an endless but fatal chain.

Maskalonge at Chautauqua Lake have the same deplorable habit and must be liberated as soon as they can fairly swim.

In marine fish culture the lobster has an equally bad record, as it begins to destroy its fellows as soon as it leaves the egg.

Migratory Habits

Certain fish, for example, whitefish and smelt, are naturally inclined to wander away from their customary spawning grounds and especially when the same places are netted year after year. This habit sometimes causes delay or partial failure in the egg collecting season.

Fish Parasites

One of the most universal and deadly parasites of fish and fish eggs is the common fungus of the fresh waters (Saprolegnia), generally known as the salmon fungus. This pest reproduces both sexually and non-sexually, and it attacks living tissues as well as dead organic matter. Its ravages are not diminished by removing all the diseased fish in a body of water, because its spores are almost constantly present in streams and an epidemic is liable to break out at any time. Salt water kills this fungus and, if properly employed, it does fish no injury.

Another very troublesome parasite of a different nature is frequently found in the gills of brook trout in some Adirondack waters. This is a fish

louse belonging to the order of copepods; but it is one of the degraded forms that fasten themselves securely in the gill blades and feed upon the life blood of the victim. Fish culturists when describing trout thus affected speak of them as "lousy or grubby." This parasite attacks the older fish and when it is present in large numbers it destroys them. In the larval condition it swims freely at the surface where it may easily become the prey of surface feeding fishes, and herein lies the only available remedy or preventive for this scourge. The parasite is wonderfully prolific, and when once thoroughly established in ponds or streams inhabited by brook trout it will destroy the species. Strangely enough the brown trout and the rainbow are not attacked by this louse.

For the destruction of the swimming larvae the common fresh water killy of New York is recommended, although any one of the top swimmers will probably answer the same purpose.

Still another troublesome animal in some trout waters is the hydra or fresh water polyp, a little cylindrical tube surrounded at the mouth with a number of thread like tentacles which enable it to take hold of eggs or embryos and give the digestive tract a chance to absorb the juices. In Colorado such a polyp has been observed to destroy eggs and embryos. In the Adirondacks, where there are thousands of the hydra in the hatching troughs at certain times, it is not certain that it does much injury. At Caledonia there are not enough of these polyps to cause any alarm. There are many other parasites of trout, but the worst of the whole list in New York is the gill parasite, *Lernaeopoda salmonea.*

Fish Diseases

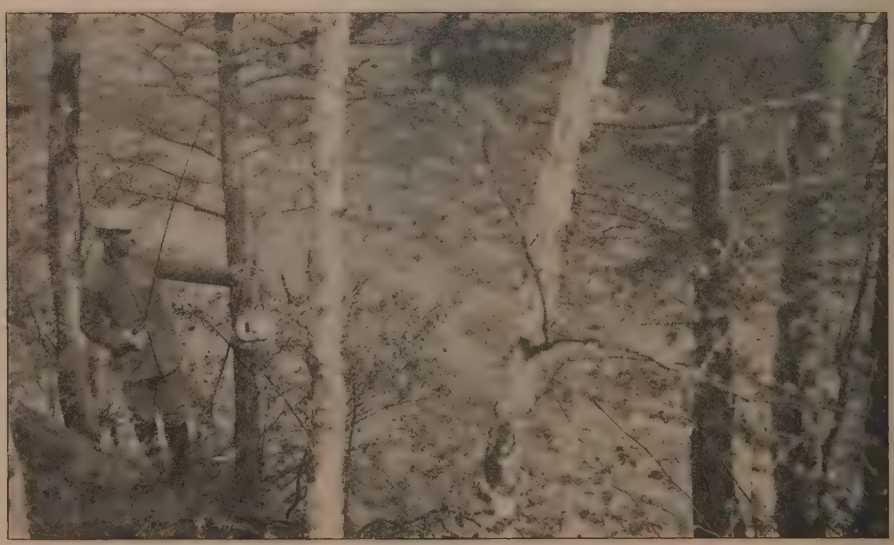
It is not my intention to enumerate all of the diseases to which fish are liable, but only such as hinder the work of fish culture most seriously. Diseases of obscure orgin or, in other words, bacterial diseases cause the greatest losses of fish. And of the bacterial diseases those which originate from filthy conditions are the worst in their effects. The skin disease of brook trout on Long Island and elsewhere, the ulcer or boil disease of brown trout are familiar and disheartening examples.

These diseases are caused by sewage and the drainage from barnyards, pig pens and similar nuisances. They are responsible for the death of thousands of fine trout whenever and wherever an epidemic occurs, and there is little that one can do to remedy the situation except to remove the cause. A great flow of fresh water will ameliorate the condition of brown trout affected by the disease, but as soon as the fish are slightly overcrowded in ponds as they are apt to be in the spawning season, the trouble breaks out with renewed and increased virulence.

Sometimes brook trout and brown trout are afflicted with "sore throat" in the spring. This condition, I am informed, has been successfully overcome by the use of common loam.

At Constantia young fish of various kinds — trout perch, yellow perch black bass, pike perch, etc.— are attacked by a bacillus that destroys one or both of the eyes. The amount of destruction is sometimes frightful in the spring and summer months. No remedy is known, in fact next to nothing is understood about the nature of the bacillus.

There is a great field for work for bacteriologists in our fish cultural establishments, but all of them appear to be so much occupied with other subjects that they cannot heed our "cry from Macedonia."



The Scarcity of Ruffed Grouse in 1907

By E. Seymour Woodruff.

Photo. by Herbert K. Job

THE ruffed grouse (*Bonasa umbellus*), more commonly known as partridge in the north and pheasant in the southern and middle states (though it has no generic relation to either), is pre-eminently the king of all our game birds.

In this State, as well as in all parts of its range, except perhaps the extreme northern portion of Canada, the ruffed grouse is strictly nonmigratory and a resident throughout the year, breeding wherever found.

It is partial to an undulating and hilly country, one well wooded and covered with considerable undergrowth, interspersed with cultivated fields and meadow lands. But with the continued destruction of the timber and consequent increase in cleared and cultivated land, this noble bird has steadily decreased in numbers, and in some sections been almost entirely exterminated. Fortunately, however, there is still plenty of cover left to harbor the birds, and because of the more strict enforcement of the game laws of late years, they have managed to hold their own fairly well during the last decade and until the beginning of the past year (1907). And this in spite of the increasing army of sportsmen, who give the bird but little rest throughout the open season, as well as the numerous four-footed and winged enemies that prey upon it at all seasons.

The testimony of sportsmen from all sections of the country is almost unanimous that grouse were more abundant at the close of the shooting season of 1906 than they had been for several seasons past, and therefore every one had good reason to anticipate that the open season of 1907 would be one of the best in several years.

But soon after the shooting season of 1907 opened, communications began to appear in local newspapers and sporting magazines, calling attention to an unusual scarcity of grouse in the several localities in which the writers resided. As the season advanced, reports from different parts of the northeast, indicating that the same condition of things existed in all localities, were published so frequently that it soon became evident that some calamity had overtaken the grouse between the close of the shooting season of 1906 and the opening of that of 1907. These reports came not only from all sections of the State of New York, including Long Island, but also from the whole of New England, Southern Canada, New Jersey, Pennsylvania, and even as far west as Michigan and Minnesota. With but two or three exceptions, hunters agreed in stating that the grouse were extremely scarce in their vicinity in the fall of 1907, and in some localities they seem to have been practically exterminated.

Various theories have been propounded to account for this scarcity, but these are for the most part merely conjectures. It is unfortunate that the remarkable diminution in numbers had not been noted much earlier in the year and at the time the causes to which the scarcity is due were at work, for we might then have been able to determine exactly what was the trouble. However, enough data have been gathered on which to base an explanation which may be accepted as substantially correct.

Before coming to any conclusion, it will be well to take up and discuss each of the several theories proposed, with the facts given to substantiate them.

The following theories have been offered as a possible explanation of the grouse scarcity:

1. The deep snow and extreme cold of the latter part of the winter of 1906–7, killing off the old birds by freezing and starvation.

2. The unusual abundance of foxes, goshawks, and other bird and animal enemies.

3. The unusually cold, wet and late spring of 1907, chilling the eggs and killing such of the young birds as were successfully hatched.

4. The extreme dryness during July and August, 1907, killing practically all the young and many of the old birds through their inability to find water.

5. An epidemic of disease. (Most of the data given to substantiate this might apply equally well to the following theory.)

6. An internal parasite.

7. An external parasite ("ticks").

8. Shooting and snaring by pot-hunters during the closed season.

9. The resumption of an innate migratory instinct causing the birds to leave the section in which they had been raised.

Discussion

1. Many people put the blame on the intense cold and scarcity of food in the latter part of the winter of 1907, but only two reports that might support this theory have been seen.

In Saratoga county, N. Y., a game protector reports that "old birds were found frozen in the early spring."

Mr. H. S. Kimball, Boston, Mass., in a letter to *Forest and Stream*, November 23, 1907, writes: "Last February a man brought in a grouse he had found in the highway starved and frozen. Two other similar incidents occurred, and the result of a canvass made in three towns revealed five different men who had picked up dead birds during that month."

But these were only exceptional cases, and do not prove anything. The grouse is too hardy a bird, and can and has withstood far more severe winters than that of 1906–7, without any appreciable loss in numbers. Besides this the grouse is just as scarce in those portions of its range where the winter was not so extremely cold.

2. The responsibility for the destruction of the grouse is laid by many to an unusual abundance of foxes, goshawks and other bird and mammal enemies during the winter of 1906–7, and the following data are given to support this theory.

Reports from game protectors and sportsmen in Chemung, Essex,

Herkimer, Oswego, Otsego and Schuyler counties, New York, state that there was an unusual abundance of foxes, skunks, hawks and owls in these localities during the winter of 1906–7, and give this as the cause or one of the causes of the scarcity of the grouse.

"J. N. C." of New Florence, Pa., writes in *Forest and Stream*, November 23, 1907: "The scarcity is not due to a disease, but to a bad season for hatching, and, worst of all, foxes. To show how numerous this latter pest is in this section, it is only necessary to say that one trapper in this locality last month caught no less than eighty-six foxes, almost entirely of the gray variety. The destruction that foxes wage among grouse is almost beyond belief. Not only is the setting hen bird killed on the nest and the eggs destroyed, but if she escapes and the hatch is brought out, the chances are ten to one that the whole brood will disappear down the never-satisfied maw of the foxes."

Two other letters from Pennsylvania speak of the great increase in foxes.

Raymond S. Spears, Little Falls, N. Y., in *Forest and Stream*, December 7, 1907, gives an abundance of foxes and other predatory animals in the Adirondacks as one of the chief causes of the scarcity of grouse. He writes that foxes, weasels and owls caught by trappers last winter had an unusual amount of fat on their bones; "a very good indication that birds and small animals were having a hard winter."

Frank Ashman, Cornwall Bridge, Conn., in *Forest and Stream*, December 7, 1907, writes: "Last winter I was in the woods nearly every day, and I found where thirty-three partridges had been killed and eaten. Thirty had been killed by owls and hawks, one by a fox, and one by a wild cat, and one by an animal of some kind, I could not tell what. This is the truth about a section eight or ten miles in circumference in Cornwall, Conn."

Edward F. Staples, East Taunton, Mass., in *Forest and Stream*, December 7, 1907, writes: "In this section at least, there are four reasons for the scarcity of ruffed grouse: over-supply of foxes, goshawks, a cold, late spring, and the loss of our pine woods. Ticks are not guilty this time. * * * When the season closed last year there were a nice lot of birds left, an ample supply if all had gone well; but in December the goshawks came down from up north and they were the fiercest raiders I

ever saw. They harassed the birds until April. One day in March I heard something strike the stable. I went out and saw a goshawk stoop and pick up a grouse that had flown against the stable window. I know of five that they drove against houses and killed within a short distance of my place. I have seen them (goshawks) three times before — once in fifteen years, say — but only one or two at a time."

William Dearden, Springfield, Mass., writes in *Forest and Stream*, December 28, 1907: "Last fall and winter we had an unusually large flight of goshawks. They were feeding on grouse all winter. Then came a bad breeding season, followed by an overabundance of foxes. * * * I examined the stomachs of about thirty goshawks last season; twenty-five of them contained grouse, three poultry, and two were empty. A pair of goshawks can take more grouse out of a patch of woodland in a few days than two or three hunters could in the entire open season. I think the fox does the most damage to the hen bird on the nest and the young birds before they can fly."

The flight of goshawks during the fall and winter of 1906–7 was one of the most remarkable on record. As a rule these birds of the far north are considered a rare winter visitant within our borders, but occasionally they come down in fairly large numbers, having been forced to leave their customary winter haunts because of some unusual scarcity of food. The following extract from an article written before the 1st of March, 1907, and, therefore, before the coming scarcity of grouse was suspected, is particularly interesting. It was written by Mr. Ruthven Deane of Chicago, one of the foremost ornithologists of this country, and appeared in the *Auk* for April, 1907 (Vol. XXIV, No. 2), under the title "The Unusual Abundance of the American Goshawk (*Accipiter atricapillus*)":

"We have this season (1906–7) been visited by an unusual influx of these bold robbers of our game. * * * Messrs. Angel and Cash, taxidermists, Providence, R. I., have had a very extended experience this season with the goshawk, and with their usual appreciation of the value of scientific records, have kept careful and accurate data of the sixty-five specimens which passed through their hands between October 27, 1906, and February 12, 1907. All of these hawks were received from twenty-two towns within a radius of from three to thirty miles from Providence,

R. I.; ten from Connecticut and sixteen from Massachusetts. * * * Mr. Cash writes me that this is the most remarkable flight of goshawks in his section since 1870, the numbers exceeding those of that date. He also states that hunters have reported a *great abundance* of ruffed grouse, and examination showed that a large percentage of these hawks had been feeding on this noble game bird. * * * A careful examination of the stomachs of forty-eight specimens showed the following results: twenty-eight contained the flesh and feathers of the ruffed grouse, in one instance a whole foot being found; five contained the flesh and feathers of domestic fowl; four contained partly digested flesh not identified, and the stomachs of eleven were entirely empty. One specimen * * * when shot was standing on the body of a ruffed grouse which she had just killed."

A number of other reports from all parts of the north and east are given, testifying to a similar abundance of the American goshawk. There can be no question but that these destructive birds of prey were responsible for a tremendous loss of life among the grouse during the six months they were with us.

3. By far the most generally accepted theory accounting for the scarcity of the ruffed grouse, is that it is due to the exceptionally cold, wet and late spring of 1907 chilling the eggs and killing such of the young birds as were successfully hatched.

This has been given as the probable explanation by many sportsmen and game wardens in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey, Pennsylvania, and Michigan, and from the following counties in New York: Broome, Cattaraugus, Chemung, Cortland, Dutchess, Essex, Franklin, Greene, Herkimer, Jefferson, Madison, Monroe, Onondaga, Oswego, Otsego, Putnam, Rensselaer, Rockland, St. Lawrence, Saratoga, Schoharie, Suffolk (Long Island), Tioga, Tompkins, Ulster, Warren and Westchester.

Mr. Mathewson, game protector in Oswego county, N. Y., reports: "Lots of nests found with abandoned eggs."

In Jefferson county, N. Y., a nest was watched, and only one out of the clutch of thirteen eggs hatched out.

Mr. Charles H. Mowry, president of the Anglers' Association of Onondaga County, in speaking of the grouse scarcity said: "Last spring was cold and backward and nests of frozen eggs were found."

"F. J. D.," Owego, Tioga county, N. Y., writes in *Forest and Stream*, November 30, 1907: "Two or three parties have told me that during the spring they found nests of the partridge with the eggs rotten and the nests abandoned."

A report from Essex county, N. Y., says: "Broods were three or four birds short on the hatch."

Dr. L. B. Bishop, of New Haven, Conn., writes: "A boy living in eastern Connecticut found several nests in which the eggs did not hatch, and after being sat on for a long time were deserted."

In western Connecticut (Litchfield county) the writer learned of the finding of several abandoned nests containing rotten eggs.

The exceptions to the many reports stating that few or no broods were hatched are as follows:

A. C. Hurlburt, Providence, R. I., writes in *Forest and Stream*, November 16, 1907: "The spring hatch was a good one and the chicks were not hampered by severe weather."

"Hackle," Boston, Mass., writes in *Forest and Stream*, November 23, 1907: "Plenty of evidence is at hand that the chickens were hatched successfully. The mystery is what became of them afterward."

Allegany county, N. Y.: "Partridges seem to be more numerous than last year — fifty birds seen a day." (Report of game protector.)

These three reports are so widely at variance with the testimony from all other parts of the country that they must be considered as covering purely local conditions.

Further proof of the failure of the regular spring hatch may be found in the data given below. It will be noted that with only one exception the observers state that all or nearly all the birds shot in 1907 were old birds, and most of them cocks. Scarcely any young birds of the year were seen, and these were very likely from late broods.

Where no authority is cited, the observations were reported by New York State game protectors.

Broome county, N. Y.—"Very few old and *no* young birds shot."

Cattaraugus county, N. Y.—"Almost all old cocks — only one or two young."

Chemung county, N. Y.— (a) "Very few old and no young." (b)

" Every gunner whom I have talked with in the two States (New York and Pennsylvania) says he killed no young birds to speak of, but did kill very large and strong, healthy old birds, and mostly cocks."— (E. H. Kniskern, Elmira, N. Y., in *Forest and Stream*, December 28, 1907.)

Dutchess county, N. Y.—" Almost all are old birds."

Greene county, N. Y.— (a) " Out of nineteen killed, only one was a hen and all were old birds." (b) " All were old cocks."

Jefferson county, N. Y.—" All were old cocks."

Onondaga county, N. Y.— " Very few birds and these are nearly all old cocks."— (Syracuse *Post-Standard*, November 12, 1907.)

Putnam county, N. Y.—" Almost all are old birds."

Schoharie county, N. Y.—" Only old birds were shot."

Tioga county, N. Y.— (a) " Only old birds were shot." (b) " Only three or four young killed."— (T. J. D., Owego, N. Y., in *Forest and Stream*, November 30, 1907.)

Tompkins county, N. Y.—" All old cocks — no hens or young."

Westchester county, N. Y.—" Almost all are old birds."

Connecticut, Litchfield county.—" All birds killed were old and mostly cocks."—(Philip Coe, Litchfield, Conn.)

Connecticut, New Haven county.— Out of sixteen birds killed, only two were young birds. " The general opinion is that the infrequency of young birds is wholly due to the cold, late, wet spring. All of the first brood being killed by the unusual weather. This is borne out by the fact that all the young birds that have been shot were of *late broods.* * * * The evidence seems to me rather conclusive that unusual weather conditions is the primary cause of the dearth of young birds."— (Prof. James W. Toumey, Yale Forest School, New Haven, Conn.)

Massachusetts.—" The large part of the birds that have been killed in Bristol and Barnstable counties this season have been old birds, and it is very seldom one gets a chicken partridge."— (F. H. B., Boston, Mass., in *Forest and Stream*, December 28, 1907.)

Michigan.—" It has been noticed by every one that nearly all are single birds and old ones."— (William B. Mershon, Saginaw, Mich., in *Forest and Stream*, December 7, 1907.)

The only report seen that is contrary to the above is the following:

South Middlesex, Mass.—"There have been but few grouse killed in this section, but a good proportion of those killed have been young birds."—(R. L. Eaton, in *Forest and Stream*, December 7, 1907.)

The scarcity of hens may also be laid at least indirectly to the cold and wet spring for the following reason: There is good reason to believe that the ruffed grouse is polygamous, but whether so or not, it is well known that as soon as incubation begins the cock leaves the hen, not to return till the chicks are nearly grown. Incubation lasts from three to four weeks, and during that time the hen has to forage for herself, leaving her eggs only for short intervals during the warmer part of the day after incubation has begun. She is very loath to do so even then, as may be judged from her permitting herself to be almost stepped on before flushing from her nest. Taking all this into consideration, what can be more reasonable than to believe that during the extraordinary spring of 1907 she would have been even more loath than ever to leave her eggs exposed to the cold, inclement weather, and so, weakened from exposure and lack of food, she fell an easy prey to disease or to foxes and other enemies.

The cock birds, on the contrary, having no family cares to burden them, were able to seek shelter during cold and stormy days and nights and to forage at will throughout the day, thus keeping in good condition. That they suffered no appreciable loss in numbers, if any at all, through later attacks of disease or parasites, or from any other cause, may be accepted as probable when we consider the following facts: It seems fair to assume that there is on the average one hen for every cock (though if the belief that grouse are polygamous is correct, the hens should outnumber the cocks). Again it seems fair to assume that at least one-third of the average brood of twelve to fourteen chicks reach maturity in normal years. This would mean that at least six birds would constitute the average family. Then if, as in 1907, all or nearly all the hens and young were destroyed, the proportion of birds left would be as one to six — the one being the cock. But in all the estimates that have been seen, comparing the number of grouse in 1907 with that in 1906, none places the proportion lower than one to six. The majority place it at about one to four or even higher. Therefore when we consider the number of cocks that were shot in 1907, it would seem probable that they were practically as numerous as in the

preceding year, for if they had perished to any appreciable extent from the same causes which carried off the old hens and the young, the numbers of grouse would have been much less than they are reported to be.

The following extracts from the monthly section reports of the Climatological Service of the United States Weather Bureau for April, May and June, 1907, will show conclusively what unusually severe weather the ruffed grouse had to undergo during the past breeding season.

APRIL, 1907.

New York. Mean temperature for the State, 39.5°, was 4.6° below normal. The weather during the entire month was very unseasonable, and it was the coldest April since the Climatological Service was established in 1875. Freezing temperatures were general over all sections throughout the month. Precipitation was slightly above normal, frequent, well distributed, and heaviest toward close of month. The average snow fall for the State, 8.5 inches, was heavier than that of March.

New England. The weather conditions in New England were more like those that usually prevail in March. The average temperature, 40°, was the lowest of any April for the past eighteen years. Twelve to eighteen inches of snow fell in the interior on the 8th, 9th and 10th — the most severe storm of the winter.

New Jersey. Mean temperature, 45.2°, was 4.5° below normal and lowest for thirty-one years. Freezing temperatures at night with destructive frosts up to the 22d inclusive. Average depth of snow was 4.7 inches.

Pennsylvania. Mean temperature, 43.6°, was nearly 5° below normal and the lowest in eighteen years. Either rain or snow occurred almost daily throughout the month. Average amount of snow for the section was 4.3 inches. The abnormally low temperature retarded the growth of all vegetation and at the end of the month the season was from two to three weeks late.

Michigan. April was an unusually cold month with persistent northerly winds, more than the usual amount of cloudiness, and much more snowfall than normally occurs. Mean temperature for the State, 35.1°, was 7.8° below normal, and it was the coldest April that has occurred

in Michigan since 1874. Average snowfall was 8.1 inches, as against the normal of 1.9 inches.

MAY, 1907.

New York. Mean temperature for the State, 50.4°, was 6.2° below normal and the lowest for May since the establishment of the Climatological Service. Freezing temperatures were general over all sections of the State, including Long Island; on the 12th and on several days at the close of the month the temperature fell to or below the freezing point. Killing frosts occurred throughout the month till the 30th. Average snowfall was 2.1 inches, and the percentage of sunshine was below the average.

New England. The marked feature of the month was the very low average temperature and the absence of the warm days that usually occur in May. The average temperature, 49.9°, is the lowest that has been recorded and is 5.4° below the normal. Snow fell as late as the 11th, the latest date on record.

New Jersey. The monthly mean temperature, 55.4°, was nearly 5.5° below normal and the lowest for twenty-five years. Almost steadily below normal with unseasonably cool nights throughout the month. Freezing temperatures on the 5th, 12th, 22d, 29th and 30th. Frequent and heavy rains with low temperatures retarded growth in all districts and the season at close of month was unusually backward.

Pennsylvania. The mean temperature, 54.8°, was more than 5° below normal and the lowest in eighteen years. Frosts and freezing temperatures were frequent throughout the month. Snow flurries occurred in many localities with considerable amounts in the northern counties. There was a large amount of cloudiness and this with the abnormally low temperatures greatly retarded all vegetation. The season was three weeks late.

Michigan. May was an unusually cold month with more than the usual amount of cloudiness and snowfall, and was a continuation of the very unseasonable and backward spring weather that has prevailed since the 1st of April. It is the coldest May on record. Mean temperature, 44.5°, was 7.6° below normal. The average snowfall for the State, 2

inches, was unusual and the greatest on record for May. Killing frosts were general as late as May 28th.

JUNE, 1907.

New York. Unseasonable temperatures prevailed during first half of the month, the nights being unusually cold, and killing frosts occurred. There was much cloudiness during the first part of the month.

New England. The unseasonably cold weather that prevailed in New England during the month of May continued through the first fifteen days of June. The maximum temperatures were much below the normal.

New Jersey. The abnormally cool weather continued through the first part of June. The mean temperature up to the 14th inclusive being 8° below normal.

Pennsylvania. The coolest June in eighteen years.

Michigan. The unusual and unseasonably cool weather which prevailed throughout the State from the 1st of April did not terminate until nearly the middle of June. The first eight days were decidedly cooler than normal and a continuation of the previous sixty days of abnormal coolness.

4. The theory advanced in the following letter that the extreme dryness of midsummer was responsible for the scarcity of ruffed grouse has but little data to support it in view of the fact that it was not so extremely dry in every locality, while the grouse scarcity was universal.

"Plenty of evidence is at hand that the chicks were hatched successfully. The mystery is what became of them afterward. Almost entire lack of water is probably the solution. * * * Last summer brooks and swamps which he (George L. Myer, of Millis, Mass.) never saw dry before, were many weeks without water, and the same conditions prevailed in other sections of the State."—(Hackle, Boston, Mass., in *Forest and Stream*, November 23, 1907.)

August was an unusually dry month. The average amount of rainfall in the State of New York was only 1.53 inches and the lowest on record since the Climatological Service was established, but the streams and swamps did not become dry in all localities. The grouse were just as scarce

in localities where there was plenty of water to be had all through the summer. The dryness, however, may have produced a condition favorable to the growth and spread of an infectious disease or parasite, and for that reason may be considered a secondary cause of the scarcity.

5. The theory that an epidemic of a disease of some kind carried off the ruffed grouse is supported by many, but is difficult to prove or disprove at this time. There can be no question that an epidemic of some kind killed many birds during the summer months, as may be judged from the testimony given below, but whether it was a disease or a parasite, or both, is now difficult to determine. In fact, much of the data given below might apply equally well to the parasitical theory.

Cattaraugus county, N. Y.— Three old birds were found dead on nest.

Greene county, N. Y.— (a) "Early in the season partridges were numerous and are now very scarce. All birds that are being killed are old ones. There does not seem to be any young ones. * * * The young die about two-thirds grown, and must have died from a contagious disease, as there were four or five found on one-fifth acre of ground, all appearing to have died about the same time and all seemed to look as if they had died from the same disease, as their heads had turned blue, feathers were all ruffed up, and a yellowish discharge from the vent. This is one out of many just such reports."— (D. C. Speenburgh, Hunter, N. Y., game protector.)

(b) — "We met a fellow-sportsman who had hunted three days in Greene county, where there generally are plenty of birds, and had given up in disgust. He said that the birds had died off in the late summer from a sickness similar to blackhead in turkeys, the natives having found the bodies in the woods."— (Trojan, in *Forest and Stream*, December 14, 1907.)

Rockland county, N. Y.—"Fourteen young and one old partridge found dead in a bunch and in another place six were found dead" (see parasitical theory).— (I. E. Mather, Haverstraw, N. Y.)

Schoharie county, N. Y.— "Seven dead chicks found dead close to nest."

Tioga county, N. Y.— "I have also heard of a farmer who * * * found three dead partridges (about November 1st) which had the appearance of being dead for at least a month. The consensus of opinion in this

locality is that a disease of some kind has worked havoc among the grouse." — (F. J. D., Owego, N. Y., in *Forest and Stream*, November 30, 1907.)

Rensselaer county, N. Y. — "I have heard one or two unauthentic reports of young grouse being found dead during the latter part of July and August." — (Charles K. Hall, East Schodack, N. Y.)

Connecticut. "Some one found several old grouse dead near their nests with a discharge from their nostrils." — (Dr. L. B. Bishop, New Haven, Conn.)

Massachusetts. "A good number of broods hatched and got half grown and then disappeared. I know of one bunch of eight fine birds that disappeared between August 5th and 12th. It seems that nothing less than some widespread disease swept them off." — (R. L. Eaton, South Middlesex, Mass., in *Forest and Stream*, December 7, 1907.)

Ontario, Canada. "There is no doubt that the agency at work was an epidemic disease which has swept through the country from the infection of which few have escaped. Many woodsmen have told me that they have found partridges dead in the wilds, while I myself have picked up some." — (Alfred J. Horsey in *Rod and Gun*, January, 1908.)

Several other letters from parties in Massachusetts, Connecticut and New Jersey tell of broods that were watched and that suddenly disappeared in midsummer. But all such data will apply equally well to the parasitical theory.

Many other people ascribe the scarcity as due in their opinion to a disease, but just as many disagree with this and think it due to some other cause. To have determined this absolutely it would have been necessary to have performed a bacteriological investigation of the birds found dead, but unfortunately the havoc was done long before the wide-spread scarcity of grouse was known.

In the early part of the last century the grouse of England and Scotland were severely decimated by an epidemic of the "grouse disease." Just as in the present case in this country, many theories were advanced to explain the destruction of the birds. Intestinal parasites were found in great numbers in grouse dying of "grouse disease," but they were found equally numerous in grouse that were otherwise perfectly healthy. After careful post-mortem and bacteriologic investigations, however, the trouble

was proved to be due to an infectious disease caused by a microbe, a variety of *Bacillus coli*.

Circular No. 109, Bureau of Animal Industry, Department of Agriculture, is a preliminary report on a disease that has become prevalent among all quail (Bobwhite) received by dealers in live birds from Alabama, Kansas and Indian Territory, and which appears to be infectious. Whole shipments were wiped out.

Bacteriological investigation of these proved that the cause was a microbe similar to that found in the "grouse disease" of England and Scotland.

The quail on a 30,000 acre preserve near Georgetown, N. C, have been practically exterminated by this disease. In 1906 the quail were abundant there and in the spring of 1907, 1,800 birds from Alabama were planted in addition. The latter were infected and the disease spread from them to the native birds, killing them all.

The above cases have been cited simply to show the possibility that a similar disease may have developed among our grouse.

The best argument against the theory that an epidemic of some disease was in itself alone responsible for the destruction of the ruffed grouse, is that which has previously been given to explain the large proportion of old cocks to hens and young which were killed in the fall of 1907. In other words that if there was a disease, it was merely secondary, and serious in its effect only because of the weakened condition in which it found the majority of the birds; a condition due to the inclement weather of the breeding season.

6. The scarcity of ruffed grouse is thought by a few to be due to an internal parasite.

Mr. Charles K. Hall of East Schodack, N. Y., writes that he met an old lady in Washington county who laid it to the "white worm." "She said, when dressing some birds this fall she had noticed a little sore place, or what might be a shot hole, in the breast, and upon cutting it open had found a worm from two to three inches long, and about the size of a small match."

Mr. I. E. Mather of Haverstraw, Rockland county, N. Y., writes:

"14 young and 1 old partridge found dead in a bunch, and in another place 6 were found dead—all with a tick (?) in their heads."

W. T. D., Brooklyn, N. Y., writes in *Forest and Stream*, December 28, 1907: "One bird * * * had, buried in its skull, a grub-like parasite which had bored in close by the eye."

John W. Babbitt, Derry, N. H., writes in *Forest and Stream*, December 28, 1907: "I did shoot two young partridges out of one flock, in the cavities of which I found white worms, some 3 or 4 inches in length. Otherwise they seemed to be smart and in good condition."

Mr. G. Ernest Hubbard of Middletown, Conn., found a long white worm in the intestines of each one of twenty-nine birds shot.

Prof. James W. Toumey, Yale Forest School, New Haven, Conn., writes: "So far as my observation goes, the birds shot have been in good condition and I do not believe that parasites have been any more disastrous than in other years."

There is enough evidence to prove that many birds were infected with a parasite, but nothing to prove that this would have been fatal to them. The birds found dead by Mr. Mather may have died from some other causes (*e. g.*, disease) as was found to be the case in the grouse disease of England and Scotland.

7. The theory that the ruffed grouse were killed by "ticks" is supported by many.

The tick (*Olfersia americana*) is an external winged parasite belonging to the fly family (*Diptera*), and which infests hawks, owls and grouse.

Mr. A. C. Hurlburt, Providence, R. I., writes in *Forest and Stream*, November 16, 1907: "The scarcity of grouse being accounted for by the long period of drought during which the ticks flourished to such an extent as to almost exterminate the birds. * * * The spring hatch was a good one and the chicks were not hampered by severe weather, and had it not been for the inroads of the parasites, excellent bags would have been made."

Mr. I. E. Mather, Haverstraw, Rockland county, N. Y., in a second letter states: "I find out it is a tick or a flea with wings, that has destroyed lots of young partridges and their mothers, found in bunches, old and young dead. Lots of these fleas on them during the summer."

The fact that ticks were abundant in some sections does not prove anything, for in most localities they do not seem to have been any more prevalent than in recent years, and in many not noticed at all while the grouse scarcity was universal.

8. The scarcity of the ruffed grouse has also been attributed to their being shot and snared by pot-hunters during the closed season. This may have been a contributory factor in a few restricted localities, but pot-hunting is not so widespread nor so serious throughout the whole range of the ruffed grouse as to be accepted as an explanation of their universal scarcity.

9. That the scarcity of ruffed grouse is to be explained by the resumption of an innate migratory instinct causing the birds to leave the section in which they had been raised, is a theory advanced by an individual in Connecticut, and backed by a purely theoretical argument.

This theory can hardly be sustained. Granting it to be true that this was a migratory year and that the partridges left the localities in which they were raised, where did they go to? Migrating birds move from one locality to another and a movement of this kind is always marked by an increase in the number of birds in that locality which is thus invaded. But no reports have been seen from any locality testifying to any such invasion or increased in the numbers of grouse. So this theory can be dismissed as unsubstantiated.

Conclusions

The writer believes that the wholesale destruction of ruffed grouse during 1907 cannot be attributed to any one factor, but that it was due to an unhappy combination of three separate factors, each one of which alone was serious in its effects.

They are:

1. The unusual abundance of foxes and, particularly, goshawks during the winter of 1906–7.

2. The extremely cold, wet and late spring of 1907.

3. An epidemic of some disease or parasite, or both, just which we cannot now determine.

The most serious of these was unquestionably the cold, wet and late spring of 1907, which was universal throughout the range of the ruffed

grouse, and which almost entirely eliminated the normal increase to be expected. Furthermore, it was also at least indirectly responsible for the destruction of most of the adult hens and such of the young as were successfully hatched, by so impairing their vitality that they quickly succumbed to the third serious fact — a disease, or parasite, or both.

The destruction caused among the grouse by foxes and goshawks, especially the latter, was more serious in its after effects than would first appear. This becomes evident when we consider that for every pair of adult birds killed during the winter there must be a corresponding loss of the brood that these two birds would be expected to raise the following spring. In other words a total loss of from 8 to 16 birds for each pair killed.

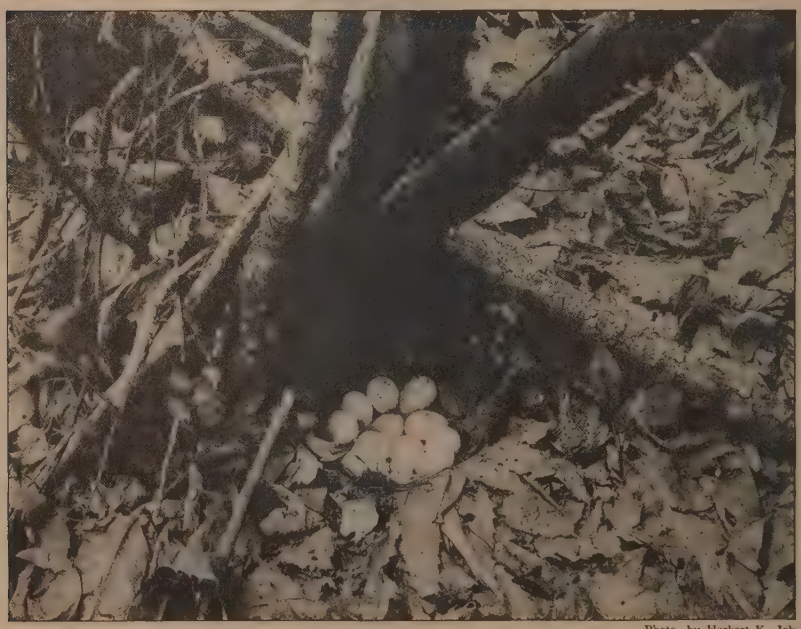


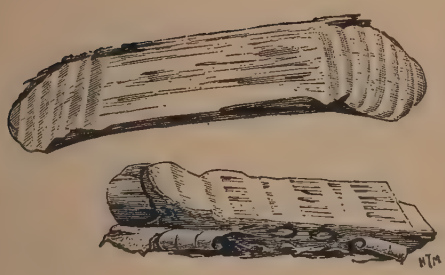
Photo. by Herbert K. Job

History of the Adirondack Beaver

(*Castor canadensis*, Kuhl.)

Its Former Abundance, Practical Extermination, and Reintroduction

By Harry V. Radford, M.Sc., C.E.



BEAVER CHIPS.

FOR at least thirty years the erroneous opinion has been held, almost universally, that the beaver became extinct within the borders of New York State sometime about the middle of the last century. Not only has this opinion prevailed among the masses of the people, but it has been shared by many persons whose special interests, either as naturalists or sportsmen, would seem calculated to promote careful investigation, leading to the discovery of the facts. What seems especially surprising is that most of the people residing within the Adirondack region — the portion of the State in which the last families of beavers have taken refuge for half a century — do not know to-day, and have not known for many years, of the existence within their own territory of lineal descendants of the original beaver stock.

Until three or four years ago, when a more general interest in the history of the New York beaver was aroused, through an organized effort commenced by the State, at the writer's solicitation, to repopulate our northern forest with these valuable and interesting fur-bearers, hardly one in ten of the guides, hunters, trappers and lumbermen, who spend a large part of their lives in the woods of the Adirondacks, knew that there were any wild beavers remaining; while among the farmers, mechanics and others

residing in the cleared areas skirting the wilderness, the number of the uninformed was much greater. This universal misconception has been due, probably, largely to the fact that the operations of the few remaining beavers who lingered on in the Adirondacks were, with scant exceptions, restricted, by their own choice, to a single small area northwest of the Upper Saranac Lake, almost wholly included within Township 20, Franklin county. Occasionally, some of them wandered to a considerable distance from the locality named, as was proven by the discovery, in 1898, of fresh signs along the Congamunck Creek,* southeast of Indian Lake, Hamilton county, eighty miles by water from their usual rendezvous; but such instances were wholly exceptional and not likely to come under the observation of more than a very few persons.

The public press of the State during the past forty years has repeatedly reflected the general opinion that the beaver was extinct. The same inaccurate statement has been published in county and town histories and similar works of reference presumed to be reliable. Even the naturalists have gone astray. In 1893, William B. Marshall, the Assistant State Zoologist, in a catalog of "The Mammals of New York, Exhibited at the World's Columbian Exposition," Chicago, reports the beaver "extinct in New York."† The preceeding year Horace T. Martin, F. Z. S., author of *Castorologia*, a valuable work upon the beaver exclusively, mentioned hereafter, had pronounced the Adirondack beaver extinct.‡ Two or three years ago a writer in the *Essex County Republican*, published at Keeseville, in the course of a series of articles purporting to give the natural history of all the animals in Northern New York, described the beaver as "formerly abundant in the Adirondacks, but now extinct." Even the last report§ of the New York State Forest, Fish and Game Commission was not free from a misstatement. In the article on "The Squirrels and Other Rodents of the Adirondacks," by the late Frederick C. Paulmier, New York State Zoologist, this appears: "In New York State the rodent population

* In October of that year Mr. W. T. Campbell, of North Creek, N. Y., found a small beaver house on the inlet of Rock Pond, which enters the Congamunck.

† Forty-seventh Annual Report, N. Y. State Museum, 1894, p. 44.

‡ *Castorologia*, p. 140.

§ Eighth and Ninth Reports, bound and issued as one.

numbers twenty-eight species, and of these the largest, the beaver, is now extinct. Attempts, however, are being made to reintroduce him into the Adirondacks, two small colonies having recently been placed in different parts. It is to be hoped that this experiment will prove to be successful, for the beaver is the most interesting of the rodents, and everyone knows of his tree-cutting and dam-building operations."

One recent writer who has not fallen into the popular error is Mr. Madison Grant, secretary of the New York Zoological Society and of the Boone and Crockett Club. In his article in the same report, entitled "Notes on Adirondack Mammals, with Special Reference to the Fur-Bearers," he says (page 327): "The abundance of beaver is subject to fluctuation, and the animals will sometimes almost disappear from an entire district. They can readily be restored to the Adirondacks, and if left undisturbed will rapidly multiply. Several pairs of beaver have been recently liberated in the North Woods, and if this good beginning is followed up, these interesting animals and their works will again be seen along our streams and lakes. * * * A few still linger on in the North Woods."

Literature of the Subject

Innumerable short sketches upon the American beaver have appeared in all countries and languages since the discovery of this continent. Some of these have been published in the journals of the early explorers, some in scientific periodicals and popular magazines, while others have appeared as brief references in "Natural Histories" whose extensive scope made full treatment of individual species impossible.

The vast majority of these articles have been valueless except as curious examples of the credulity, inventiveness or deliberate prevarication of their authors; or, even when authentic, have been too brief to give more than a superficial description. No animal of the New World has been the subject of so much baseless romancing and color work.

There are, however, at least two notable exceptions. The article upon the beaver taken from the Journal* of Samuel Hearne, a Hudson Bay

* *A Journey from Prince of Wales's Fort to the Northern Ocean.* London: 4to, 1795, ch. VII, p.226.

explorer of the eighteenth century, is very valuable, and was for over a century the basis of most of the succeeding descriptions. It is still quoted extensively. The short treatise* on the beaver of Bennett, an Englishman, published in 1835, is also deserving of note. In his book, *Lake Champlain and its Shores*, W. H. H. ("Adirondack") Murray quotes in full an article on the beaver of nearly three thousand words by one of the early settlers of Vermont, Dr. Samuel Williams, LL.D., which has some merit, but is not wholly free from the inaccuracies common to the early treatises.

The passage devoted to the beaver in Hornaday's *American Natural History*† is excellent so far as it goes, but is necessarily brief, and so leaves much unsaid. There is a longer description in Ingersoll's *The Life of Animals (Mammals)*,‡ which is equally trustworthy. In Richardson's *Fauna Boreali Americana*, in the works of Coues and Allen and J. K. Lord, and in the *American Naturalist* for 1877 and 1878 are good delineations of the beaver's habits.

THE "POND DOG" (BEAVER).

ILLUSTRATING UNRELIABILITY AND EXTRAVAGANCE OF EARLY DESCRIPTIONS.

From an old print, 1755.

Three books have been published in this country treating exclusively upon the beaver, and one in Canada. These are:

The American Beaver and His Works, by Lewis H. Morgan. Philadelphia: J. B. Lippincott & Co., 1868.

Beavers: Their Ways, by Joseph H. Taylor. Washburn, N. D.: published by the author, 1903. 2d ed., revised and enlarged, 1906.

Shaggycoat; the Biography of a Beaver, by Clarence Hawkes. Philadelphia: George W. Jacobs & Co., 1906.

Castorologia; or, The History and Traditions of the Canadian Beaver, by Horace T. Martin, F. Z. S. Montreal: William Drysdale & Co., 1892.

All of these have considerable merit, particularly the first, which is a reference work of the highest class and thoroughly reliable. *Beavers:*

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* In *The Gardens and Menagerie of the Zoological Society* [of London] *Delineated*. Quadrupeds. Vol. I, p. 153.

† Published by Charles Scribner's Sons, New York, 1904.

‡ Published by The Macmillan Company, New York, 1906.

Their Ways, is not the work of a finished author, and has been rather crudely put together, but it is written by a practical man who has spent a lifetime in the beaver country and has known his subject intimately.

Castorologia, as its sub-title indicates, is devoted more to the historical aspect of the beaver than to its natural history, and is less the result of original investigation and thought than are the former two.

LE BEAU'S MARVELOUS VISION.
From an old print.

Shaggycoat is an attractive popular animal story, rather than a serious work of reference.

All of these books contain excellent illustrations from photographs and drawings, giving a very clear idea of the appearance of beaver dams, huts, canals, etc. Morgan's and Martin's, in addition, have valuable maps and diagrams.

Some of the magazine articles appearing in recent years are very interesting, and while, on the whole, rather inclined to overcoloration, are not entirely without value for reference purposes.

Among those deserving of mention are:

"The Beaver," by H. P. Wells. Ills. by A. B. Frost. *Harper's Magazine*, Jan., 1889.

"The Story of the Beaver," by William Davenport Hulbert. Ills. by A. Radcliffe Dugmore. *McClure's Magazine*, April, 1901.

"Haunts of the Beaver," by A. R. Dugmore. *Everybody's Magazine*, Dec., 1901.

"The Story of the Trapper (1. The Taking of the Beaver) ", by A. C. Laut. *The Outing Magazine*, Jan., 1902.

"Beaver Ways," by Frank H. Risteen. Ills. by Tappan Adney. *The Outing Magazine*, March, 1903.

"Bringing Back the Beaver: Its Successful Reintroduction to the Adirondack Region," by Harry V. Radford. Ills. from photographs by the author. *The Four-Track News*, April, 1906.

So far as I am aware, no monograph has heretofore appeared upon the Adirondack beaver exclusively; and the only serious treatment the subject has received consists of two brief passages in works devoted to mammals in general. James E. DeKay's *Zoology of New York*, published in 1842, has twelve hundred words upon the beaver, and Dr. C. Hart Merriam's *Mammals of the Adirondacks* (1882 and 1884) has eighteen hundred words. Beyond these, except for seven hundred words of Madison Grant's article, previously mentioned, I am not aware that the beaver of our Adirondack region, has ever received separate treatment, save in insignificant paragraphs or mere sentences contained in brief and doubtful articles upon the wild animals of this locality. Miller's *Preliminary List of New York Mammals*, published in 1899 as a bulletin of the New York State Museum, which is the only serious work upon the quadrupeds of this State since Merriam's treatise, is silent upon the beaver so far as new facts go. He has simply this: "The beaver is probably nearly exterminated if not quite extinct in New York. Concerning the animal's status I have nothing to add to the account given by Merriam in 1884."

YOUNG BEAVER.

Photo by W. H. De Graff.

ADULT.

Courtesy of N. Y. Zoological Society.

Former Abundance

When we compare the present paltry numbers of the Adirondack beaver (there cannot be above an hundred in the whole region to-day, 1907) with its wonderful abundance in primitive times, an astounding discrepancy appears. Three hundred years ago, when Samuel de Champlain, in 1609, sailed into the lake that bears his name, and—first of all white men—saw the beautiful mountains that rise along its western side, the beaver, within the area now known as the Adirondacks,* was probably as plentiful as it had ever been. For an unknown period, this area had been the dividing line between two hostile races of Amerinds:† a sort of "dark and bloody ground," into which even the aborigines did not often penetrate, except on warlike excursions. On the whole, the interior portion of the Adirondacks is strangely devoid of Indian remains, and it is presumable that much of the territory was seldom or never visited by them. They seem to have confined their travels, when passing backward and forward on their way to battle, to the water routes afforded by the St. Lawrence, Black, Mohawk and Hudson Rivers, and Lakes Champlain, George and Ontario, lying along the borders of this area, and not to have gone far into the central forest in any direction. It is quite certain that before the coming of the white man, the Indian's meagre pursuit of the Adirondack beavers, with his inferior appliances for capture, had never made any practical diminution in their ranks; and in 1609 it may be supposed that they were in the full flower of their abundance.

If, as is said by the Dutch author quoted by Merriam,‡ the province

* For the purposes of this paper, and for simplification, we may roughly define this area as being bounded on the north by the Canadian line, on the east by Lake Champlain and the Vermont line, on the south by the Mohawk River, and on the west by Lake Ontario and the St. Lawrence River. It comprises about one-third of the area of the State and contains, roughly, 16,000 square miles, which is practically equivalent to the combined areas of Massachusetts, Connecticut and Rhode Island. St. Lawrence, Franklin, Clinton, Essex, Warren, Washington, Saratoga, Fulton, Hamilton, Lewis and Jefferson counties are included, and parts of Herkimer and Oswego.

† Amerind: a word now in use among some scientific writers as an equivalent for "American Indian," of which it is a contraction. It deserves a more general usage.

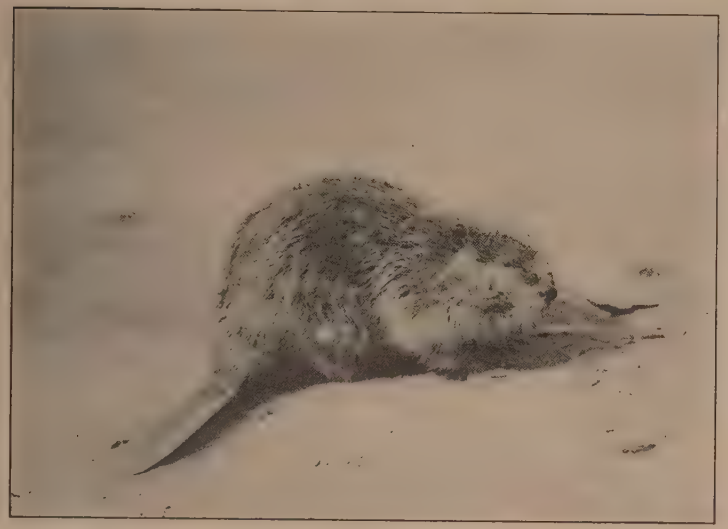
‡ *Vid.* "De Nieuwe en Oubekende Wiereld: of Berchrying van America en't Zuidland: don Arnoldus Montanus," in *Documentary Hist. of N. Y.*, vol. IV, pp. 120–121.

of New Netherland furnished to the fur trade in 1671 "full eighty thousand beavers a year," the number living in the area included by New York State at the time of Champlain's visit must have been enormous—not improbably several millions.

All the evidences show that the beaver was fully as abundant in the Adirondacks as in other parts of the State; so that if, dividing by three, we make the assumption that there were one million beavers in the Adirondacks at the commencement of the white man's settlement, we have an estimate probably as accurate as could be deduced at the present time. Judging from the extensive remains of the beavers' occupancy, still visible in all parts of Northern New York (such as beaver meadows and remnants of dams), it is evident that every lake and pond was occupied, and every river, brook and rill, from the largest to the most insignificant, thickly peopled with these industrious and prolific animals. They seem to have completely possessed the land, and to have been abundant almost beyond our present conception.

The Indian did not especially value the beaver, and it was not then—as it soon after became—the principal object of his pursuit. Beaver fur was used occasionally as covering and for ornamentation, and the hides were sometimes made into moccasins, but the beaver pelt was never in superior demand among them. The flesh of the beaver was highly prized by almost all of the North American tribes; but as the Indian is essentially omniverous,* and moreover was exceedingly careful not to waste animal life, it could not be said that he ever made serious inroads upon the beaver colonies for the purpose of sustaining life. Indeed, the Indian and the beaver seem to have lived, on the whole, peaceably together in the same wilderness, and there are many records to show that beaver colonies were

* In addition to the deer, moose, wapiti, raccoon, hare, rabbit, duck, goose, grouse, and other wild game prized so highly by the white settlers of this continent, the Indian killed, ate and relished the bear, porcupine, muskrat, skunk, woodchuck, squirrel, wood mouse and many other animals deemed unfit or unsavory by most of his successors. They were very fond of the flesh of dogs; and some of the western tribes even carry the eating of grasshoppers to injurious excess. Wild fowl and birds of all kinds, fish, reptiles, crustaceans and mollusks, fruits of many varieties, cereals and grains, vegetables (wild and cultivated), roots, shrubs, wild plants and grasses, and even the bark of trees, all contributed towards sustaining the life of the primitive wild Indian.



IN VARIOUS POSTURES.

Courtesy of N. Y. Zoological Society.

often established almost within earshot of populous Indian villages and permanent encampments. It is known that the Indians had a superstitious regard for the beaver,—even associating him with the creation of the world,—which may have had some influence on his practical immunity from their pursuit.

First Fur-Trading Posts

In 1603 the first fur-trading post in Canada was established at Tadousac, on the Saguenay; the second at Stadacona (Quebec) the following year. Three Rivers was founded soon after; but it was not until the establishment of Ville Marie (Montreal) in 1611 that the fur trade began to assume conspicuous proportions in the New World. At the south, the first permanent settlement by the Dutch was at Fort Nassau, near Albany (1614), and New Amsterdam (1626).

The southern part of the Adirondacks was then nominally the hunting grounds of the Five Nations, of whom the Mohawks were the most active. They claimed the land northward to a line running due west from Mohawk Rock* (Rock Dunder) in Burlington Bay. This would include all the wilderness south of the Saranac Lakes. To the north of this line were the Algonquin tribes, restless and ever eager to push their dominion southward.

When the French at the north and the Dutch and English at the south commenced a bitter struggle for control of the fur trade, the Adirondack region became the scene of a new kind of warfare; for, from that day forward, keeping pace with the bitter war of extermination between the rival races,—the French and Algonquins at the north, the Dutch, English and Iroquois at the south,—raged an incessant war—not less merciless or brutal—upon all forms of fur-bearing animals, but especially against the beaver. The Indians, at times, even forgot their ancient animosities to unite in a common assault upon the inoffensive beaver, and, for the first time in their history, the glass beads, looking-glasses, firearms and "fire-water" of the white invaders, lured them to forget their former providence and moderation in the chase. They became inveterate and remorseless beaver killers. The region was overrun with trappers, both red and white,

* *Vid. Lake Champlain and Its Shores*, by W. H. H. Murray. Boston: DeWolfe, Fiske & Co., 1890. Pp. 75–81.

and the slaughter, thus inaugurated, never ceased while there were beavers enough in any part of the Adirondacks to make systematic trapping worth while. As a rule, the pelts taken by the Algonquin and white hunters in the northern part of the wilderness eventually reached France, through Montreal, while those taken in the southern part by the Iroquois, Dutch and English, found their way, *via* Fort Orange (Albany) and New Amsterdam, to Holland or England.

The Beaver Hat; Early Slaughter

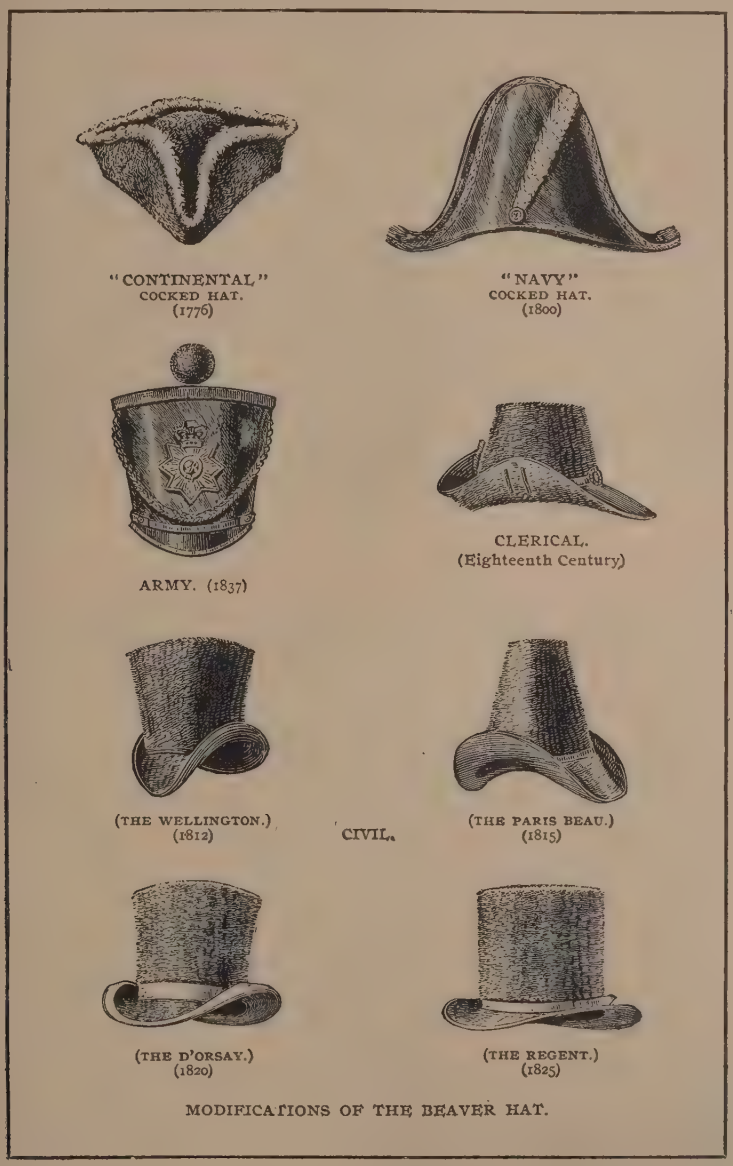
The beaver hat was now established as an article of fashion throughout Europe and America, and so highly was it prized that we find, in 1663, as much as £4 5*s* was paid for a good beaver hat. Previously Northern Asia had been the chief source of supply, but America soon took the lead and has held it ever since.

From the establishment of the French and Dutch trading posts on both sides of the Adirondacks early in the seventeenth century, until the beginning of the nineteenth,— almost two hundred years,— the pursuit of the beaver continued without any abatement. The numbers that were annually killed are almost past belief. The Hudson Bay Company alone, in a single year, exported 175,000 skins,* many of which undoubtedly came from the Adirondacks, while it has been shown above that the annual exportation from the colony of New York reached or exceeded 80,000. As early as 1623 the importance of the beaver to the Dutch colony was so well recognized as to lead to its incorporation in the seal of New Netherland.

An idea of the excessive destruction which was carried on may be gained from the following statement by Martin: "The annual returns from Prince of Wales Fort alone reached 20,000 beaver skins, and though at that time the exports [from Canada] included a long list of valuable articles, the quantity of beaver skins represented two-thirds of the entire value. A most extraordinary crisis was reached in the year 1700; for some time prior to this, the collection of beavers had been so excessive as to partly glut the market, but in the year mentioned, the number of beaver

* *Vid. Castorologia.*

skins collected at Montreal was so enormous, that three-fourths of the collection were burned, to make the other portion worth exporting."



MODIFICATIONS OF THE BEAVER HAT.

We can readily see, that, with such methods of slaughter prevailing, the beaver of the Adirondacks, surrounded on all sides by hungry trading

posts, and mercilessly trapped by Red and White alike, could not long maintain their existence in this narrow area, especially as this animal, so sagacious in many respects, is very easy to capture — much more so than the majority of the fur-bearing animals. In this fact we have an explanation of why the beaver, once so abundant, has been entirely extirpated in localities where all the other native mammals are still found.

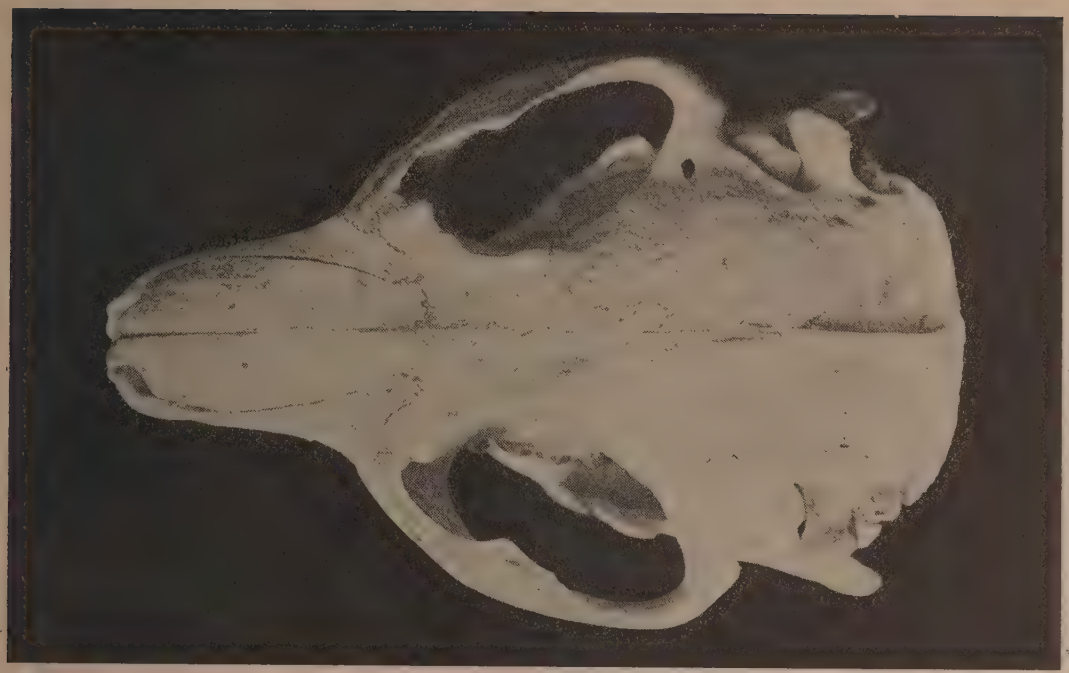
It should be mentioned in passing that, while the beaver was sought primarily to supply the hat manufacturers with its fine, soft wool (which was clipped from the hide and pressed into felt), this was not the only product which had commercial value. The shaved skins themselves were utilized in the manufacture of glue, the oil was used for several purposes, and the castoreum, a mucilaginous secretion found in two pear-shaped sacs immediately below the pubis, had been highly valued in medicine for ages.

About 1794 the Indians discovered the remarkable virtue of castoreum as a bait for beaver, and almost at the same time steel traps began to be generally used. These two very effective innovations sealed the doom of the Adirondack beaver, and before the second decade of the next century had elapsed it had been practically annihilated in that region.

Timely Substitution of Nutria

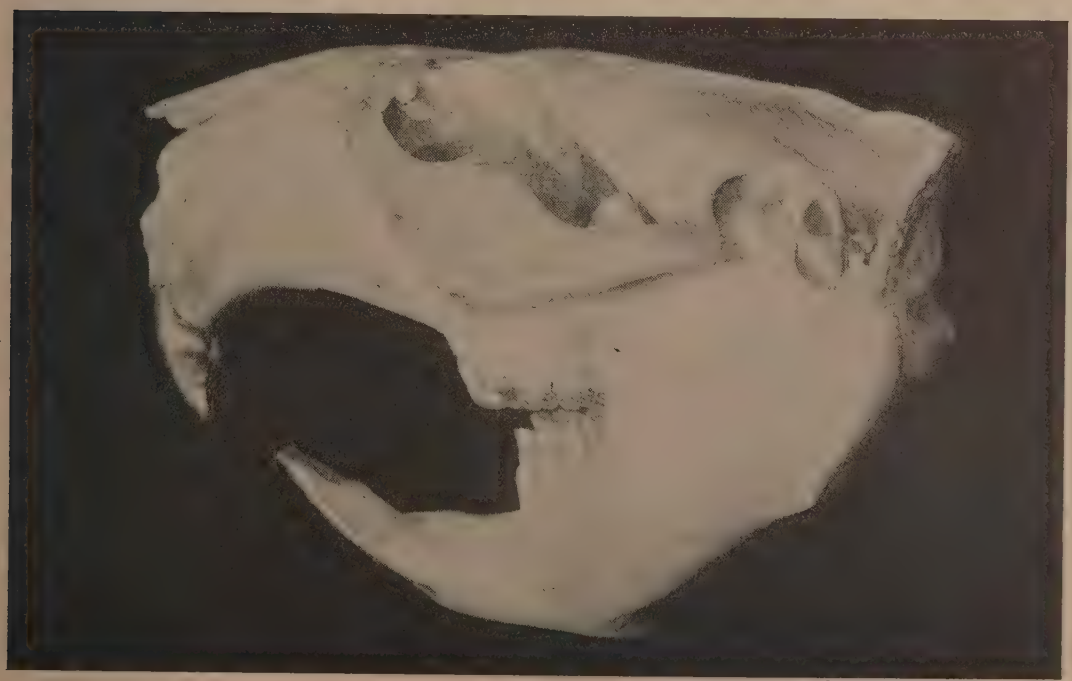
It is probable that in the year 1800 there were not 5,000 beavers in the entire area of Northern New York, and that by 1820 the number had been diminished to less than 1,000. The same rapid course of extermination was in progress throughout the entire continent, and it is evident that, long before the outbreak of our American Civil War, the historic beaver of this State would have been as completely extinct as the Irish elk or the dodo, had not the timely discovery been made that the fur of the South American coypu was as good as, if not superior to, that of the beaver for the manufacture of hats. Martin says:

"The river rat, or coypu, as it is called by the natives, is in many ways the intermediate species between the musquash [muskrat] and the beaver, and having been known as the 'Castors of La Plata,' might appropriately be named the South American beaver. It inhabited chiefly Brazil, Chili and La Plata, where it is very numerous; it is the only known representative



SKULL OF YOUNG BEAVER (C. CANADENSIS) — TOP VIEW.

NATURAL SIZE.



Courtesy of W. T. Hornaday.

SKULL OF YOUNG BEAVER (C. CANADENSIS) — SIDE VIEW.

NATURAL SIZE.

of the genus *Myopotamus*, and attains nearly half the average size of the beaver, and like the musquash, the coypu is very prolific.

" Its introduction to commerce was very recent though of great importance, and the fact should not be overlooked that but for its contribution to the hatters, our Canadian beaver would not have survived so long. All accounts from North America during the latter half of the last century [the eighteenth] which made reference at all to the fur trade, agree in stating that the beaver would soon be extinct; but about 1820 the immense demand was relieved by this new fur, called *nutria* — (from the Spanish, *nutra*, the otter). The fur was plentiful and cheap, and sufficiently fine to supplant the beaver for all hatters' purposes, but had the discovery of silk been longer delayed it is doubtful whether the increasing demand could have been sustained for many years. When the silk hat succeeded to the enviable position which the 'beaver' for centuries had monopolized, it became necessary to find another outlet for the skins which hitherto had been consumed almost exclusively by the hatters' trade. We, therefore, find the furriers introducing the manufacture of the tanned or dressed skins into their business, and nutria, the skin of the coypu, is to-day among the best imitations of beaver, otter and seal."*

Early Adirondack Records

In 1815, DeKay states, " a party of St. Regis Indians from Canada ascended the Oswegatchie river, in the county of St. Lawrence, in pursuit of beaver. In consequence of the previous hostilities between this country and England, this district had not been hunted for some years, and the beaver had consequently been undisturbed. The party, after an absence of a few weeks, returned with three hundred beaver skins. These were seen by my informant [Mr. T. O. Fowler], who adds that since that time [1815] very few have been observed."

Merriam's records of beaver killed during the next two decades are worth *verbatim* copy, as by that time the beaver had become so rare that individual cases are of interest. He writes:

* *Castorologia*, p. 35.

"They were not immediately exterminated, however, for Mr. Calvin V. Graves writes me that in 1834 a trapper named Hume caught six beavers in Silverdog Pond, in the northeastern part of the town of Diana, in Lewis county, and that a few years later Norman and Hume caught three beavers on the middle branch of the Oswegatchie, near Harrisville. These are believed to have been the last beavers which inhabited that part of the wilderness.

"I am informed by William Clowbridge, an old hunter and trapper, that during his boyhood beavers were common along the western border of the Adirondacks. In the year 1819 he caught two in one of their huts on the outlet of Brantingham Lake, in Lewis county, on which stream they had then two dams. In March, 1837, he caught at Little Otter Lake, also in Lewis county, the last beaver observed on this side of the Adirondacks. The veteran hunter, Asa Puffer, was at the time trapping for the same animal. Mr. Clowbridge tells me that the spring was unusually forward, and that there was some open water along the north shore of the lake, and about the outlet. He made a small opening in the dam, and in the gap thus formed set his trap, a few inches below the surface of the water. On returning to the lake, a week afterward, an eagle was seen to rise and fly away from the vicinity of the outlet. Proceeding to the dam he could find neither the trap nor the weight to which it had been attached. He then went to the spot from which the eagle rose and there found the beaver in the trap.

"Mr. John Constable has kindly presented me with the skull of a very large beaver which was 'trapped by William Wood, in the fall of 1837, in a pond northwest of Indian Point on the Raquette.' Mr. Constable writes me that an old Indian who had been unsuccessful in his attempts to capture this same beaver, and who was then about to leave this part of the wilderness, told Wood where the animal was to be found. Wood carried his boat to the pond and paddled twice around it, searching carefully for signs, without going ashore. At last he discovered fur upon the root of an old birch that projected into the water. Here he placed the trap, attached to a float, and on the second day found the beaver in it."*

* *Mammals of the Adirondacks*, p. 254.

MONEY POUCH MADE OF TANNED KITTEN BEAVER'S TAIL.

SLIGHTLY REDUCED.

Despite the decreasing demand for beaver skins, due to the extensive substitution of nutria and of muskrat and rabbit fur, and the fact that the popularity of the "beaver" hat began to wane about this time,* there was little if any cessation in the war of extermination carried on against them. It was found that the dressed skins were serviceable for small articles, such as caps, collars, cuffs, muffs and gauntlets, and as the population of the State was now rapidly increasing and hunters and trappers becoming every day more numerous, the ranks of the beaver continued to be thinned with merciless rapidity.

DRIED CASTOREUM POUCHES. (AFTER MARTIN.)

POPULARLY CALLED "BARK-STONE" OR "BEAVER CASTORS."

In 1830 I estimate the beaver population of the Adirondacks to have been about 500—perhaps less.

In 1842, DeKay, who, as State Geologist of the extensive Natural History Survey carried on by New York for several years commencing in 1836, made excursions in the Adirondacks for the express purpose of investigating its mammalia, wrote:

"The beaver, whose skins once formed so important an article of commerce to this State as to have been incorporated in the armorial bearings of the old colony, is now nearly extirpated within its limits. * * *

"In the summer of 1840 we traversed those almost interminable forests on the highlands separating the sources of the Hudson and the St. Lawrence and included in Hamilton, Herkimer and a part of Essex counties. In the course of our journey we saw several *beaver signs*, as they are termed by the hunters. The beaver has been so much harassed in this State that it has ceased making dams, and contents itself with making large excavations in the banks of streams. Within the past year (1841) they have been seen on Indian and Cedar Rivers, and at Paskungameh or Tupper's Lake; and

* It did not finally drop out of fashion until 1870. A few old beaver hats are seen occasionally even to-day, worn by elderly men.

although they are not numerous, yet they are still found in scattered families in the northern part of Hamilton, the southern part of St. Lawrence and the western part of Essex counties. Through the considerate attention of Mr. A. McIntyre, those yet remaining in the southern part of Franklin county are carefully preserved from the avidity of the hunter, and there probably the last of the species in the Atlantic States will be found. We noticed the remains of an old and large beaver dam at the outlet of Lake Fourth in Herkimer county, but it is now nearly covered up by the drift sand from the lake." (*loc. cit.* p. 74.)

At the time of DeKay's journey the beaver must have been very rare. He states that in the course of his travels through the wildest interior portions of the Adirondacks, he had seen "several beaver signs," but he does not mention that they were fresh or recent, as he would have been almost certain to do had they been so. In all probability they were cuttings a few years old, and perhaps some small dams and deserted houses, not yet destroyed by the elements; although, of course, he might have seen some fresh signs, as beavers were not absolutely unknown at that time in the section through which he passed.

Rapid Decrease Since 1840

In 1840, judging from what I have heard from old hunters, and gathered from other sources, I should say that there were probably not to exceed three hundred beavers in the Adirondacks. About this time, or a little earlier, the beaver became finally extinct in all parts of the State outside of the Adirondacks.*

Their numbers now dropped away rapidly, and henceforth they became greater rarities than "panthers" (pumas) or wolves, which continued in considerable numbers until about 1885. At the mid-century (1850), there were perhaps seventy-five beavers living in the North Woods, and they were mostly confined to the central core of the region; that is, southeastern St. Lawrence, southern Franklin, western Essex and northern

* However, beavers, believed to have escaped from a private preserve, have been observed in Orange county, in the extreme southern part of the State, in recent years, and one is said to have been killed by a railway train in that county, near Two Bridges, in 1905.

PART OF A BEAVER DAM 250 FEET IN LENGTH.

DAM CONSTRUCTED OF LARGER STICKS.

Photos by W. H. De Graff.

Herkimer and Hamilton counties. Formerly, they had been distributed in all parts of the region, though very sparsely since 1820.

In 1860, I put their number at fifty. There were probably not more than seven or eight families, and they were strung out along the Raquette and St. Regis Rivers and in the well-watered area immediately northwest of the Upper Saranac Lake (Township 20, Franklin county). There may have been a few stragglers in other places.

When Watson's *History of Essex County* was published, in 1869, this statement appeared: "The beaver was found in great abundance throughout the region, by the first occupants. They no longer exist, it is believed, in the territory of Essex county."*

Township Twenty Becomes Center of Abundance

In 1870, I should say, there were thirty beavers, consisting of three or four families and a few lone individuals. The center of abundance was now in Township 20, a section of unbroken forest, approximating seven miles square, peculiarly adapted to their needs and mode of life, and so thickly overspread with ponds and lakelets, rivers, creeks and marshes, that almost one-half of the entire area is under water. From that time, until the recent effort to restock the region was begun, there were scarcely any other portions of the woods in which fresh beaver signs were seen. Exceptions occurred at rare intervals, indicating that stragglers from Franklin county did occasionally visit other parts of the wilderness.

In 1880, we can put the total number down at twenty-five; in 1885, at twenty. They were practically confined to Township 20, and already the native hunters and trappers in other parts of Northern New York had reached the conclusion that the beaver was absolutely extinct in the State.

Mr. D. W. Riddle, the superintendent of the Saranac Inn,† who came first to that locality in 1879, informs me that when he arrived there were one or two families located on a small inlet of St. Regis Pond and on the outlet of the same. There was a good sized dam on the outlet of Little

* As quoted by Merriam.

† The Saranac Inn, a noted woodland hotel, is located at the head of Upper Saranac Lake, almost in the center of Township 20.

Square Pond. The information which he then received led him to believe that there had always been beavers in this locality, and that they had been steadily decreasing in number for many years.

By 1890 we reach conditions with which I am myself personally familiar, having made my first summer visit to these woods in that year.* There were then, according to my estimate, about fifteen wild beavers in the Adirondacks — all in the Township 20 locality. They were building small dams and repairing old ones constantly, but so far as I have been able to learn, they built no huts, or houses. Their fresh cuttings attracted the attention of hundreds of persons, and as they were located within a short distance of the Saranac Inn, many tourists from the cities were enabled to become familiar with their habits, and occasionally some persevering observer had the good fortune to catch a glimpse of one of the interesting aquatics themselves. Almost all of Township 20 was then under the control of the Inn, and the management did all in their power to protect the beavers by fostering local interest and sentiment. There is not much sentiment in the average trapper, however; and natives with steel traps hung around the vicinity of the beavers almost continually, occasionally taking one or more. Only the ignorance and blundering methods of the trappers could have saved the little colony from total destruction; still, it is almost a miracle that they managed to survive at all through the succeeding decade. In 1894 Mr. George Miller, then station agent at the Saranac Inn railway station, and Mr. Wilbur C. Witherstine, a youth of Herkimer, N. Y., shot one or two beavers close by the hotel. Mr. Witherstine's beaver was found to have one foot missing, showing that the cruel steel traps had been busy. The following fall two trappers from Saranac Lake made a descent upon the locality and took away one or more of the beavers (the exact number was never known).

This combination of disasters to the little beaver colony of Township 20 came nigh snapping, then and there, the feeble life line that had been perpetuating itself, in the face of so many obstacles, for unnumbered generations. In the winter of 1894–5 the number of beavers in the Adirondacks

* These vacation visits were continued without interruption until the present year (1907), when I took up a permanent residence in the Adirondacks.

BEAVER CANAL.

AFTER MORGAN.

reached its lowest ebb. There could not have been more than five or ten individuals — the equivalent of a single family — in the whole region, and for a time it was even supposed that there were none, as the few survivors wisely deserted their familiar haunts and hid away in less frequented corners of the same township.

Saved by Protective Laws

However, the end was not yet to be. As, when, in 1820, the Adirondack beaver was on the point of being wiped out of existence to satisfy the demands of the hatters' trade, it had been saved from early extinction by the sudden introduction of nutria, so, now, in the very nick of time, it was saved from a similar fate by the introduction of a law in the New York Legislature, and by the passing of that law. For the first time, it prohibited absolutely the taking of beavers in this State under severe penalty;* and the trappers were checked. I know not the man who drew this saving law, but to him may be attributed the fact that the beaver has never become completely extinct within the borders of this State. Naturalists, sportsmen and Adirondackers owe him a lasting debt of gratitude, whoever he may be.

Slowly the numbers of the Adirondack beaver began to pick up; and their increase soon after received an additional impetus through the inauguration of an intelligent plan to accomplish the actual rehabilitation of the woods and waters of the Northern Wilderness with each of the valuable mammalian forms which in aboriginal times had flourished there.

In 1901 an association of New York sportsmen and naturalists, organized for this purpose by the writer, obtained the passage of a law authorizing the State Forest, Fish and Game Commission to " acquire by gift, purchase or capture a sufficient number of wild moose to stock the Adirondack region "

* The law of 1895 read, simply: " There shall be no open season for beaver." The penalty for taking them was $50, and imprisonment might be inflicted. In 1904, a law, drawn by the present writer, increased the penalty to $100, and extended the protection as follows: " No trap, snare, pit, dead-fall or other device to entrap or entice beaver shall be made, set or used, nor shall beaver be taken by aid or use thereof. No person shall molest or disturb any wild beaver or the dams, houses, homes or abiding places of same." Except for an unimportant change of wording, this law, as then drawn, stands to-day.

and to "care for, herd and yard the same temporarily, and liberate them in such region at such times and places as it deems most conducive to their probable subsistence and increase." The sum of $5,000 was appropriated by the Legislature with which to make a start in carrying out this enterprise. In 1904 similar authority was given the Commission with respect to wapiti (elk) and beaver. The same year $500 was appropriated for the purchase and liberation of beaver, and in 1906 an additional $1,000 was appropriated for the same purpose.

Liberations Commenced

About the same time a few gentlemen owning large preserves in the Adirondacks commenced co-operating with the State by releasing beaver upon their lands. The first of these was Mr. Edward H. Litchfield, who, since 1901, has liberated about a dozen beavers in Litchfield Park, a very extensive private forest reservation in the southwestern corner of Franklin county. Most of Mr. Litchfield's beavers have escaped from his park to adjoining lands, and have roamed in many directions, but up to the present have confined their operations chiefly to southern St. Lawrence and Franklin and northern Hamilton counties. There are indications that these beavers have been steadily increasing, and some of them, in their wanderings, may have found the families of native stock in Township 20 and thus infused a strengthening strain of new blood. Fresh cuttings, attributed to the Litchfield beaver, have been seen at several points along the Raquette River system in recent years.

About the year 1902, Mr. Timothy L. Woodruff brought two Canadian beavers to his private preserve at Lake Kora, south of Raquette Lake, in central Herkimer county, one of which soon afterward died. The other escaped, and, wandering southward, took up a residence on a small stream entering the South Branch of Moose River, where it built a dam, about ten miles from the point of escape. Here it remained for several years, until, in April, 1905, it was joined by two other beavers which were placed by the State in the same stream, at the dam.

In the fall of 1904 the State of New York, through the Forest, Fish and Game Commission, made the first purchase of beavers for restocking the Adirondacks. These were seven which had formed part of the Cana-

dian exhibit at the Louisiana Purchase Exposition, at St. Louis. Through the generosity and public spirit of the Brown's Tract Guides' Association,* an arrangement was entered into whereby these beavers were kept through the winter at the State Fish Hatchery, at Old Forge on the Fulton Chain, the guides paying the expenses of their keep and care.

State's Temporary Enclosure at Old Forge

Mr. Henry Davidson, then foreman of the hatchery, and Guide Ned Ball,† now State Game Protector, devised a very ingenious method of keeping the beavers. A cement rearing pond, located on the hatchery grounds, about forty feet long and ten feet wide, fed by running water, which stood fourteen inches deep in the pond, was given over to the new arrivals. This was surrounded by a wire screen fence of three-eighths-inch mesh, two and one-half feet high, which was made to lean inward over the pond at an angle of nearly forty-five degrees, to prevent the beavers from climbing over. Even then, it was necessary to watch them closely, and several times during the winter they came very near escaping.

At one end of the pond a very comfortable house was erected of pine lumber, covered with tar paper. This was set up on legs over the pond, so that the floor was just above the water's level. In the center of the floor

* Too much cannot be said in praise of the public spirit and intelligent zeal of the members of this organization, and particularly of their painstaking and indefatigable secretary, Mr. A. M. Church, to whose influence was due largely the success of the plan for keeping the beavers at Old Forge through the winter. Mr. Church is a woodsman of long and wide experience, and, being also a taxidermist, his practical knowledge of wild animals is very great. His services to the cause of Adirondack game and forest preservation have been legion.

It is a pleasure to record the universal esteem in which this association of woodsmen and guides is held in the section over which its operations extend. The writer is under obligation to its officers and members for unnumbered favors and courtesies shown him during the past eight years.

† Ned Ball is one of the best known members of the Brown's Tract Guides' Association, and is a game protector by natural inheritance, his father and grandfather having been keepers on the English estate of the Duke of Buccleuch. Ned has had more experience than any other person in handling and liberating live game animals in the Adirondacks for the State — moose, wapiti, and beaver. What he doesn't know about the Adirondack woods and their wild inhabitants is not generally learned in the course of a lifetime.

a round hole was cut for the passage of the beavers in and out of their house; and, lest the water in the pond might rise suddenly during the night in consequence of a heavy rain or of the drain-hole becoming stopped up by the fine wood refuse, and the beavers' house become flooded, two rows of shelves were erected inside the latter upon which the animals could take refuge in such an emergency. The dimensions of the house were as follows: length, nine feet; width, four and one-half feet; height at ridge, four feet; at eaves, three and one-half feet.

A comfortable bed of soft, dry straw was strewn deeply over the floor of the house, in which the beavers could make warm nests, and straw was also placed upon the shelves. For the convenience of the keeper in renewing this bed and of examining the interior of the house from time to time, one side of the roof was so arranged, with hinges, that it could be raised up bodily, and the interior of the house laid open for inspection.

The seven beavers arrived at Old Forge on December 17, and were immediately placed in the rearing pond.* From the start, it was found that there were two of the beavers which the other five would not allow to enter the house. They were constantly being attacked, and one of them was nearly killed by his mates during the first night after their arrival in the pond. He was only saved by the timely appearance of Mr. Davidson, who had been awakened by the noise of the conflict. They had crowded the unfortunate beaver into one corner of the pond, where it cowered, apparently in great fear. Its tail had been severely injured by the others, and before morning was rendered worse by being frozen — the beaver being unable to take refuge in the house and having no dry place to rest.

Seeing that two of the seven beavers were not to be allowed the privileges of the house erected for them, Messrs. Ball and Davidson fenced off the pond into three sections, and built two additional houses, somewhat smaller than the first. The largest section of the pond, with the largest house, was left in possession of the five bellicose beavers, while each of the others had a house and a section of the pond to himself. The segre-

* Previously, for some days, they had been kept in the cellar of Mr. Robert Moore, of Fulton Chain, the local game protector, awaiting the completion of the house.

gated beavers, however, did not seem to appreciate the safety of their situation, for they were almost constantly endeavoring to gnaw through or climb over the wire mesh fence dividing them from their tormentors. Keeper Ball, whom these endeavors kept in a constant state of worriment, lest they might succeed in their efforts to rejoin the others, and suffer the loss of their lives as a consequence of their foolhardiness, was inclined to view their peculiar disregard for consequences as an aggravating case of misdirected valor. In fact, this very thing eventually occurred; for, despite Mr. Ball's vigilance, one of the beavers cut its way into the compartment containing the other five, and was promptly killed by them. This occurred only a few days before the others were liberated.

Mr. Ball fed the beavers once a day* during their temporary confinement, cutting for them every week a fresh supply of yellow and white

BEAVER CHIP. NATURAL SIZE.

birch (*Betula lutea* and *B. papyrifera*), alder (*Alnus incana*), poplar (*Populus tremuloides*), dogwood (*Cornus florida*), shadbush (*Amelanchier canadensis*) and striped maple (*Acer pennsylvanicum*).† He also gave them a variety of vegetables, such as apples, carrots, turnips, beets, potatoes and cabbages, of which they were quite fond. When I visited the beaver pond on January 15, 1905, they had consumed four bushels of vegetables, or about a bushel a week. They were also consuming about a cord of small brush each week, and a cord of wood. The brush was eaten entire, but the wood, which was cut into eighteen-inch lengths, and averaged three inches in diameter, they did not eat, but stripped each piece of its

* At 4 p. m.

† The generosity of the Old Forge Company deserves to be recorded here. To provide feed for the beavers, permission was given Mr. Ball to cut any kind of tree or shrub, up to four inches in diameter, on any part of their 1,350 acres of wooded land.

bark, which they consumed; then discarded the stick. These peeled sticks were collected together in a pile by Mr. Ball. There were four or five cords of this material remaining at the commencement of the spring, which were to be sold by the guides for stove-wood, at two dollars per cord, to help pay the expenses of the beavers' keep. Gradually the amount of vegetables fed to the beavers was diminished, so that just before liberation they were subsisting almost exclusively on bark and brush. Mr. Ball found that the beavers would also readily eat bread, but was obliged to keep his discovery to himself, otherwise the children of the neighborhood would have been throwing bread into the pond at all hours of the day, in the hope of drawing the beavers from their houses, that they might get sight of them.

The beaver has a peculiar call, which it utters in a low tone, and Mr. Ball soon learned to imitate this so well that he always used it at feeding time to call the beavers out of their houses.

On the day of their arrival at the pond, after a week or two of confinement, without water, in Mr. Moore's cellar, the beavers were so delighted with the little pond that they commenced damming it up immediately with such loose wood, brush, leaves, etc., as had fallen into it. This dam had to be demolished to prevent the water in the pond rising too high; and, seeing their labor unavailing, they spent the remainder of the day in splashing about in the water and washing and combing their faces and bodies.

Their method of eating apples was quite dainty. Sitting erect upon their hind legs, with their tails extended backwards upon the ground, they would hold them in their forepaws, and remove the skin with as much neatness and dexterity as the genus *Homo* might command with the aid of a fruitknife. I saw one of the beavers peel an apple in this way; and Mr. Ball said that they invariably did it so.

The Beavers' Beds

I have previously referred to the fact that the houses of the beavers, built by Messrs. Ball and Davidson over the pond, were supplied with warm beds of soft straw, deeply strewn. This was a consideration, however, which was wasted upon the beavers, for, almost as soon as they took pos-

STRAW REDUCED BY BEAVERS FROM BLOCKS OF WOOD, AND USED BY THEM FOR BEDS.

BEAVER CUTTINGS FROM THE ADIRONDACKS.

COLLECTED IN 1899 AND 1905

session of the houses, they commenced tearing up the straw and thrusting it into the pond, through the round door in the center of the floor; and soon had it all out of their houses.

Mr. Ball was greatly surprised at this performance, especially as there was no grass or leaves which the beavers could obtain to substitute for the straw; but a few days later, on raising the roof, to investigate, he found the floor and shelves strewn with a clean white substance closely resembling new excelsior or coarse straw. Upon examination, it was found to be very thin strips of wood—all eighteen inches in length, showing that they had been produced from the solid blocks. After being stripped of their bark, they had been reduced to very fine shavings by the aid of their wonderful teeth. This, then, was the material of which the beavers' beds were made. It was a valuable discovery. I have never seen this curious fact referred to in any printed work, save in Martin's *Castorologia*,* in which he quotes from the report of Joseph Stuart Black, gamekeeper of the Marquis of Bute, relative to the latter's experiment of raising Canadian beavers on a large, semi-wild area in Scotland. Mr. Black says: "As to what they use for a bed to lie on, it is wood shavings, which they prepare in the following manner: after using the bark for food, they place the stick on end, holding it with both feet a bit apart, then with their teeth pare it down into fine shavings. They are very cleanly in their habits, as they often clean out their house, not casting away the refuse, but using it either on the top of the house or the embankment of the dam to patch up a hole."

It is strange that so accurate and persevering an observer as Morgan did not discover their use of wood shavings as a bed. He states that he found grass used for this purpose in the houses which he opened when taking their measurements. Apparently, they use both grass and wood shavings, and perhaps grass is their favorite material. This they were unable to obtain at the Old Forge quarters. I tied together a little bundle of these wood shavings and took it away as a curiosity. It has a striking resemblance to a bundle of ordinary cane straw, coarse excelsior, or slivers and splints of elm wood such as are used in basket work, etc.

Toward the end of April, 1905, having heard that the ice was leaving

* Page 161.

the ponds and rivers of the Adirondacks, I hurried up from New York to join the party of guides who had volunteered to liberate the first beavers released by the State.

Releasing the Beavers

On April 27, four of us* left Old Forge in two row boats for the head of Fourth Lake of the Fulton Chain, a distance of twelve miles, carrying with us two beavers in a zinc-lined crate.† We stopped over night at Cedar Island Camp, in Fourth Lake, and the next morning were joined by Eri Delmarsh, one of the proprietors, and at Inlet (the head of the lake) by E. Van Arnam, another active member of the Guides' Association.

From Inlet we carried the beavers twelve miles by trail, over hills, through swamps and across rivers, to the lone log cabin of Frank Gray, a hermit living on the South Fork of Moose River. The crate being a very ungainly thing to handle over the rough ground traversed (part of the way through snow), we all took turns in carrying it — ten-minute shifts being the rule.

We lodged for the night at Gray's cabin, and early the next morning (April 29, 1905) carried the two beavers to a point on the small stream, previously mentioned, to which the beaver that had escaped from Mr. Woodruff had made his way.‡ At this point he had built a dam and felled a number of trees; and here we released the two beavers, hoping that they might find the solitary, and combine forces with him. This they probably

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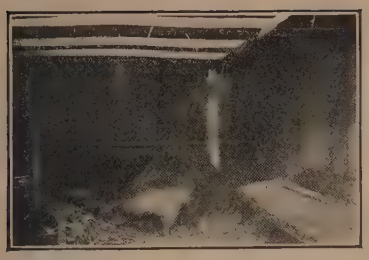
* The members of this party, besides the writer, were Frank and Ben Sperry and Stanley Weedmark. At Cedar Island Camp we were joined by Eri Delmarsh, and at Inlet by E. Van Arnam. All of these men are active members of the Brown's Tract Guides' Association. Ours were the first boats of the season to make the trip through the chain of lakes, the ice having left Fourth Lake only that morning.

† The crate, with the beavers, weighed eighty pounds. Poles were attached at the bottom in such a way that it could be carried by two men, like a litter.

‡ Throughout this article the writer purposely avoids stating the precise location of any of the points where beavers have been liberated, or where they are known to exist to-day, believing that it is best for the safety of these animals that the general public should not be informed of their whereabouts too minutely. They will be discovered soon enough for their own welfare; and meanwhile the directions given are sufficiently close for the purposes of this paper.



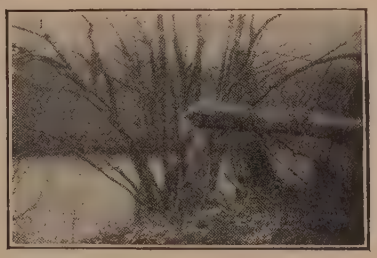
"AT HOME," IN THEIR ARTIFICIAL HOUSE.

CATCHING THE BEAVERS ON THE MORNING OF THE START.

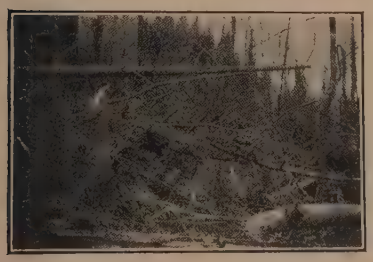
LEAVING OLD FORGE WITH A BOATLOAD OF BEAVERS.

OVERLAND THROUGH THE FOREST.

CRATED BEAVERS ON THE INLET OF BIG MOOSE LAKE.



CUT BY BEAVER ON SOUTH BRANCH OF MOOSE RIVER.



CUT BY BEAVER ON OTTER CREEK.

THE "ARMY OF LIBERATION."

THE FIRST BEAVER LIBERATIONS BY THE STATE, APRIL 1905.

Photos by Harry V. Radford.

did, for the following fall a large house was found by Mr. Gray, erected at the same point.* During the past summer (1907) Mr. Woodruff visited the locality, and he informs me by letter that he found a large and substantial dam, four feet high, and that there were then quite a number of beavers there, several of which he himself had the good fortune to see.

After completing the first liberation successfully, we made a quick trip back to Old Forge, and the following day carried the remaining four beavers to Big Moose Lake and released them upon a small stream entering near its head. Very soon afterward it was discovered that these four beavers had divided into two separate couples, as fresh cuttings and other signs were found simultaneously on the streams and ponds east of Big Moose Lake, on Township 41, Hamilton county, and along the Beaver River, in Township 5, Herkimer county, more than fifteen miles distant. These beavers have since increased considerably in numbers, and have spread their operations over a wide area.

The following year, 1906, Mr. George A. Stevens, proprietor of the Stevens House, Lake Placid, placed a single Canadian beaver in a brook entering the head of the lake, his intention being to introduce others later on. This beaver soon after descended to the lake and remained there the following summer and winter, cutting a number of small trees along the shore.

New Stock From the Yellowstone Park

During 1906 the Commission contracted with the United States Secretary of the Interior to purchase twenty-five live beavers, which were to be captured in the Yellowstone National Park, and on September 3, 1907, the first shipment of eight arrived at Old Forge, where they were received by Protector Ned Ball. Four of these beavers were dead upon arrival, but the remaining four were promptly released in a pond near First Lake of the Fulton Chain. These have since divided. Two are now on the outlet of the pond and two on a small stream on the Adirondack League Club land,

* In a letter to the writer, dated March 28, 1906, Mr. Gray described this house as being "about 10 feet [in diameter] on ground floor, 6 feet high, shaped like a haystack, gothic on outside." He adds: "Don't know what it is inside — suppose poplar finish."

Township 2, Moose River Tract, where at last report (October 2, 1907) they were doing well.

On October 13, eight more beavers arrived from the Yellowstone Park in fine condition. Four of these were released on land belonging to the State, near Fourth Lake of Fulton Chain, and the other four on the outlet of Lake Terror, Township 42, also on State land.

October 18 two more of the Yellowstone consignment arrived, and were released near the head of Little Tupper Lake, northern Hamilton county.

The following table epitomizes the liberations since 1901:

BEAVERS RELEASED IN THE ADIRONDACKS SINCE COMMENCEMENT OF THE EXPERIMENT

Released by the State	20
Released by Mr. Edward H. Litchfield	12
Released by Mr. Timothy L. Woodruff	1
Released by Mr. George A. Stevens	1
Total number of beavers released in the Adirondacks	34

Recent Rapid Increase

As a natural result of these liberations and of the protective laws of 1895 and 1904, together with a growing public interest favorable to the protection of these animals, the beaver has been on the increase steadily since 1895. By the year 1900 I estimate there were fifteen beavers in the Adirondacks. The Report of the Commission for 1905 puts the number at forty; in 1906 at seventy-five. These estimates agree with my own. At the present time (December, 1907) I should say there were about one hundred beavers in Northern New York.* It is reasonable to suppose that within a few weeks (spring of 1908) this number will be increased, by births, to at least 150.

* Three or four years ago there were well-founded reports of the presence of one or more beavers at Chippewa Bay, St. Lawrence county — on the St. Lawrence river. I am not sure whether these apparent stragglers from Canada still remain. They are not considered in the present estimate.

Photos by Harry V. Radford.

AT THE MOMENT OF LIBERATION.

For purposes of comparison, to show the rate of decrease and later increase of the beaver, the following table is here presented:

NUMBER OF WILD BEAVERS IN NORTHERN NEW YORK DURING THREE HUNDRED YEARS (ESTIMATED)

1609 (At coming of white man)	1,000,000
1800	5,000
1820	1,000
1830	500
1840	250
1850	100
1860	60
1870	30
1880	25
1885	20
1890	15
1895	5 or 10
1900	15
1905	40
1906	75
1907	100
1908	150
1909 (Three hundred years after coming of white man)	?

There are probably as many beavers to-day in the North Woods of New York as there were in 1850,— fifty-seven years ago,— and more than in 1860. They are already becoming widely distributed, and are making their appearance on many streams which have not known the presence of a beaver, or shown any marks of their occupancy, for over half a century.

What the future of the Adirondack beaver will be — whether, aided by the wise policy of restoration happily begun by the State, and supported by a friendly spirit of co-operation on the part of the people, he will continue to increase in numbers, ultimately obtaining to something like his former abundance,— it is, of course, impossible to predict, as there are so many unforeseen circumstances which may arise at any time to alter the present course of events affecting the progress of the experiment. Thus far, it has enjoyed unanimous approval and support, except upon the part of a few lawless and unprincipled trappers (fortunately inconsiderable in

number), whose perverse selfishness is only exceeded or paliated by their narrow-minded short-sightedness and ignorance of their own best interests. It is unnecessary to remark that the intelligent classes, in every Adirondack community, are warm friends of the industrious little beaver, and heartily welcome his return.

The limits of the present paper do not permit of any attempt to describe the physical characteristics, or the artificial erections, of the beaver, except casually, and incidentally with respect to the main subject — the numerical fluctuations in the Adirondacks and the recent efforts at reintroduction. Almost nothing of essential importance could be added to the splendid descriptions given in the standard volume, *The American Beaver and His Works*, by Lewis H. Morgan, published in 1868, and previously recommended, to which the reader is referred. So far as the writer knows, the Adirondack beaver has not developed any characteristic variations, either of physical form or habits, from his Hudson Bay congener, the type species, known to science as *Castor canadensis*.

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Photo by E. T. Martin.

NEW BEAVER HOUSE NEAR BIG MOOSE LAKE (ADIRONDACKS).

AN OLD BEAVER AND THREE YOUNG WERE SEEN HERE DURING THE SUMMER OF 1907.

Photo by W. H. De Graff.

FEED-BED ADJOINING A BEAVER HOUSE.

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